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By E. J. Mehren

Biography of Howard I. Young

General Manager of Mines, American Zinc, Lead & Smelting Co.

Situation at the Mines

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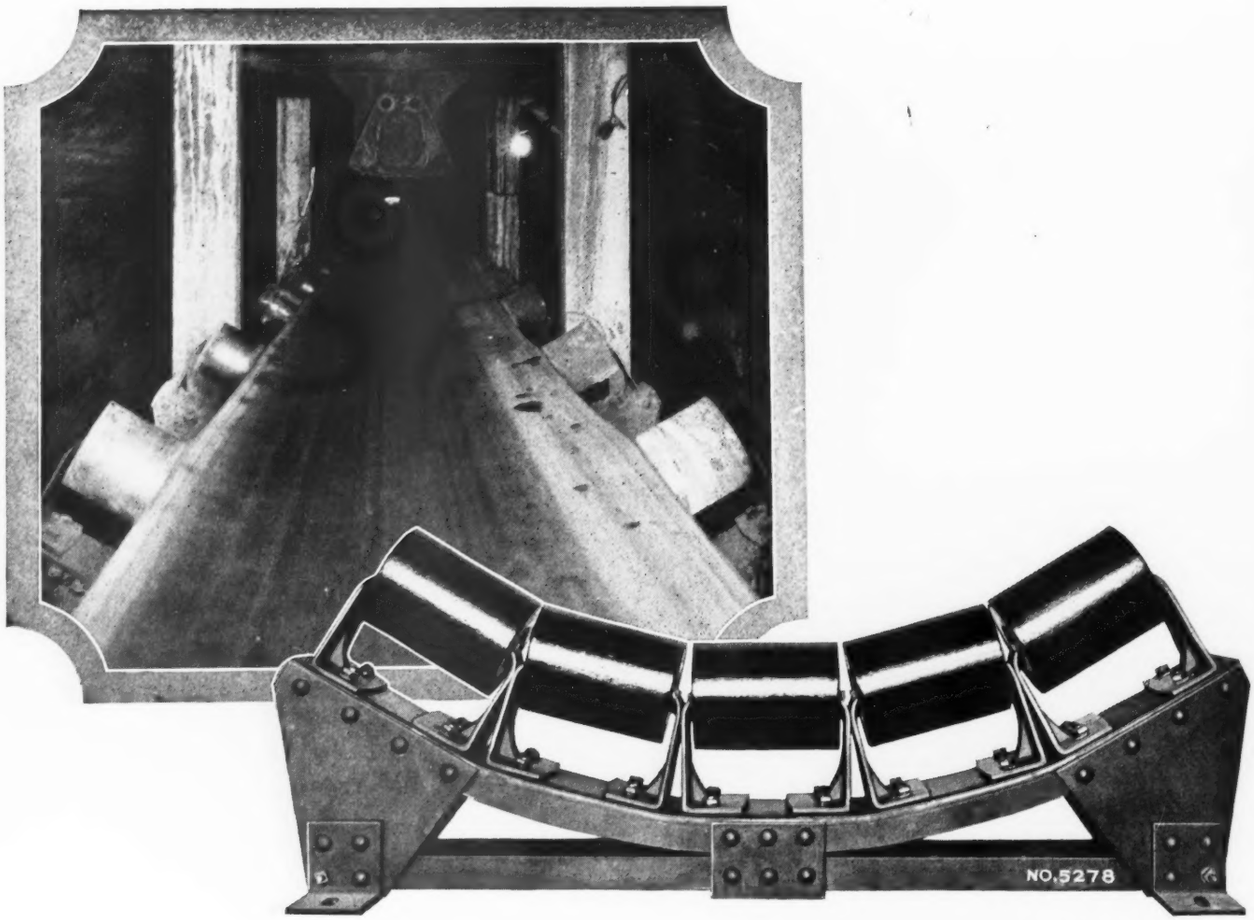

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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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An Institute for Geological Research

RESEARCH INSTITUTES, founded in most cases by private means, have easily proven their great value in advancing science. They are perhaps the most potent of artificial agents in this direction. One has only to consider the advance in medicine due to the Rockefeller Institute to realize this. Other organizations than research institutes are busy with the day's work, as are most individual students: they are too busy using their tools and their formulas to devise new ones. This is one of the booms that the wealthy have been able to confer: one of the really constructive things they have been able to do.

The rush of philanthropic feeling is naturally toward alleviating the present woes of humanity—hence the abundance of money for hospitals, libraries, homes for the aged, from public and private funds alike. The realization, on the part of the donors, of the humanitarian worth of the advancement of science demands a keener intelligence and a more profound insight. Yet there is no way that money can be invested for a greater ultimate service to humanity than for the advancement of scientific knowledge. Results obtained this way increase as at compound interest forever.

We have in the mining industries, as in other great industries, men who have been greatly fortunate; and they are as philanthropic as the average. It would be a fitting memorial to their careers and their industry if they would consider how with their money they might further the knowledge of the sciences which pertain to mining—especially the science of the occurrence and habits of ores—of economic geology. This science is in its infancy; a more exact knowledge is a crying demand. There is no organization properly prepared to push research questions promptly and persistently: the universities are occupied with their teaching, the government and state bureaus of mines and geology are occupied with surveys which are demanded as of immediate economic importance. The National Research Council has no funds or organization for actively carrying on work. It can only advise and co-ordinate. All of these elements in the organization of geological science have expressed their approval of the plan of an endowed Institute for Geological Research.

As an example and a model may be instanced the Geophysical Laboratory at Washington, which was founded and endowed by Andrew Carnegie. This is devoted to geophysics, and has functioned well and satisfactorily. The tendency is naturally to earth sciences other than geology; and it is felt that an Institute for Geological Research would stimulate and balance the geological side of geophysical experiment, and that the two institutions would be mutually supporting (in science), each without in any way duplicating the work of the other. This is also the view expressed by high officials connected with the Geophysical Laboratory.

There exists, in short, a gap in the organization for the prosecution of geological science; and the creation of an independently endowed Institute for Geological Research would fill the gap and would connect up and foster all the research work which is being done at various centers, and would forge ahead on new lines. Such an institute, on account of its unique character, would at once take a world-wide position. The Council of the Society of Economic Geologists has considered and approved this plan, as have most of the other organizations which are working on these lines. There remains the question of the launching of the ship, to which proceeding the first and indispensable preliminary is a substantial endowment, a question which has not been taken up in any way by or with any one.

Economic Experiment on a Grand Scale

WITH THE SIGNING of the London agreement by the interested countries last month the Dawes plan for a reparation settlement takes a decided step forward. In fact, Germany has already made one payment under the plan, and a citizen of the United States has been appointed transfer agent to receive the funds turned over to the Reparations Commission. The London agreement merely supplements the Dawes report by providing for an additional member of the Reparations Commission—a citizen of the United States—appointed officially by the United States Government or unofficially selected by the commission. In case of default in payment by Germany the Reparations Commission must render a unanimous decision, otherwise the matter is subjected to arbitration by another commission of which the president shall also be a citizen of the United States. Furthermore, the contemplated $200,000,000 loan to Germany is to have safeguards thrown around it in the event of sanctions being imposed upon that country. Last but not least France agrees to evacuate the Ruhr within one year, and the economic unity of Germany is promptly to be restored.

We have already alluded editorially to the Dawes plan in our issue of April 26 and to the probable effect of German payments on the copper market in our issue of April 5, 1924. Our views have not changed since, and the main postulate, that Germany will ultimately have to discharge her obligations from a surplus of exports (in the form of goods or services) over imports, grows more apparent than ever. Already, manufacturers in Europe and the United States are becoming alarmed over the prospect of meeting German competition. Chemical industries in the United States seem especially worried. It is to be noted, however, that the raw-material industries, especially the nonferrous metal producing group, are not perturbed in the slightest. Germany will have to sell her goods intensively in every available market or reparations

will remain unpaid. There is no alternative. Either Germany must be given an opportunity to accumulate a surplus from which to pay her obligation or the debt must go uncollected. Similarly, European countries must adopt an identical method for discharging their indebtedness to the United States. The transfer of huge sums from one country to another is a thorny problem, and a tremendously interesting experiment is now being made in trying to do so without violent disturbance to the business structure of the world.

Although the Dawes plan is brilliant, numerous important details have not yet been worked out and will probably arise now and then to impede the progress that is being made to settle the reparations question. However, the plan is now in action. Its effect upon world industry, its influence on manufactured and raw materials and on business in general, will soon be seen.

Men of Mars

THE APPROACH OF MARS to its nearest distance from the earth has naturally aroused the greatest interest among scientists and not less among the laity. The central point of interest has been the putative tenancy of Mars by a race of beings very much like ourselves. Since Mars is older than the earth, the reasoning ran, the people of Mars would have developed beyond us: would have long understood the use of the radio, and possibly have developed instruments through which they have ascertained the presence of humanity on earth. Doubtless, the reasoning ran, for eons they have been signaling the earth, hoping for a response. So during the recent juxtaposition of Mars and the earth, our own radio enthusiasts have listened for a Message from Mars. Some have requested silence of the radio clatter of the nations, in order that they might strain their ears. It was even reported that thumps or chugs of presumably Martian origin—possibly part of a signal—were detected.

During all this period, the newspapers—even, and especially, the yellow journals—illuminated the minds of the peepul with profuse and unfounded information concerning Mars and its inhabitants, with weird and fantastic drawings to inform those of us who cannot or do not read.

After all is said and done, what about Mars and its people? Has it people? There are certain rectilinear markings on Mars, which wax and wane. These Prof. Percival Lowell, whose observatory is at Flagstaff, Ariz., and who is a brother of President Lowell of Harvard, has long believed to be artificial canals. If canals, ergo, man—therefore Mars is inhabited. But the majority of astronomers have refused to go so far or to admit that there is any evidence of life on Mars. To be sure, romantic astronomers like Prof. Camille Flammarion, of Paris, have no doubt whatever of the existence of a Martian human society; but the poetic vision is here added to the scientific.

The proper study of mankind is man, said the poet. Certainly nothing interests man as does man. Contrast to the scores of illustrated newspaper pages about Mars and its people, the three-inch latest item recording the fact that at Lick Observatory "the score or more of astronomers who have been manning the giant telescopes here since Mars has been in opposition have concluded the planet is not inhabited." Our essay on the Martian people is therefore in danger of summing up like the famous prize essay on snakes in Ireland, which read, "There are no snakes in Ireland." The dispatch continues: "The supposed 'canals', which long have been the chief basis of scientific belief that Mars boasted animal and probably human life, much like our own, they say, are too wide to be man-made affairs, fully 100 miles across. Also, they are declared to be too winding in their courses to be the result of any Martian engineering project."

These observations, in spite of being telegraphed, are not new; it has long been known that the supposed canals have the great width stated. If they are not artificial, but natural, the populace loses interest; but to the geologist and the astronomer they should be of far greater interest, since they may furnish another clew to the development of the cosmos and the structure of our earth. And to the scientist, the conclusion that these zones are not artificial canals should not justify the unscientific and illogical conclusion that "the planet is not inhabited." The same dispatch continues: "Observations and photographs virtually have established that Mars has clouds and atmospheric conditions similar to our own, and also rivers and mountains, land and sea."

Under these conditions, which have long been known, it is highly probable—we can speak only of probabilities—that life exists on Mars. Life, according to the mysterious plan of Nature, is the evolution of chemical reactions between the atmosphere and the rocks; and given these reagents and time, it is probable that high organisms have developed on Mars as on the earth. We have reason to believe that uniform chemical laws prevail in the universe. That the process of evolution should have followed the same labyrinth of paths as on the earth, however, there is not one chance in a thousand million; consideration of the history of evolution recorded on the earth demonstrates that. Therefore, that there are men on Mars is altogether improbable. What the actual organisms are like, our present science cannot inform us; nor can imagination help. It has been shown that our constructive imagination is not the far-flying bird we sometimes think; but that it cannot move far out of our own circle of experience.

The "Electrified" Mine

IF ONE WERE DISPOSED, he might argue the inaccuracy of the writers of the news dispatches that describe the Wabigon mine near Buhl, Minn., as the "first electrified open-pit iron-ore mine." It is possible to electrify a wire, or a washing machine, or a hoist, but whether a mine can be electrified might be questioned by some. We are content to let it pass. It is significant that for the first time the equipment in a large mine of this kind is operated entirely by electric power. The machinery in the various repair shops; the shovels that dig and load the ore; the locomotives that pull the trains of stripping and of ore—all are run by electric motors.

It seems obvious that electric power distributed from a central generating plant over copper wires to the point of use is in every respect more economical than steam power generated in comparatively small engines to which bulky coal must be hauled to hundreds of localities by rail, by boat, and by truck. This is aside from the operating advantages of electricity as a source of power. Much of the credit for the progress that has been made is due to the manufacturers of electrical machinery who have designed and built the motors that

stand the "gaff" and the auxiliary electrical equipment that make the operations reliable, simple and economical. Credit, too, should be given to other manufacturers, to makers of power shovels particularly, for their initiative in building shovels that operate by electric power.

The real test of the merit of the scheme lies, of course, in the per-ton cost of delivering ore in the yard of the railroad that carries it to the Lake ports. Specific figures are not available, but electrical engineers who have worked on the project say that the cost will be less than half that of doing the same thing with steam engines at present prices of electric power and coal. Even if they are overly optimistic in their estimates there seems to be a safe margin in favor of electricity.

Positively the Last Appeal

THE BUSY PROMOTER, like the famous (or infamous) impresario, finds profit in the reiterated statement that the public, unless it seizes the opportunity now offered, may find itself unable in the near future at least to spend its money on so worthy an object as the one being promoted. Whether the exhibit in our issue of June 21 had any effect on the policy of Alois P. Swoboda we have no means of ascertaining, but we do know that an appeal for more money addressed to those who merit the title of "Friend and Pupil," was issued under date of July 23, in which each is reminded that "This is positively your last chance. . . . It is now or never." With the possibility of further publicity and its unpleasant concomitants it may be likely that he is speaking the truth.

"Even if this mine pays only $100 for every dollar invested, it will mean that $100 invested will be turned into $10,000, or $200 invested will be turned into $20,000." This is old stuff; the worm doesn't even hide the hook. But this promotion artist has a new scheme: "I have," he says, "evolved a plan under which I am willing to guarantee my pupil against the loss of a single penny." The "guarantee" is in the form of a letter to him, to be signed by the "pupil," which reads:

"I inclose.....Dollars, which please invest for me in your Valenciana proposition on a guarantee basis, in which you personally guarantee me against the loss of a single penny.

"I am hereby giving you one-half, or 50 per cent, of all profits which my investment will bring. I am doing this because you guarantee me against loss.

"In view of your guarantee, I hereby give you complete control over my investment. You are to hold the shares in my name and possession and to collect dividends or to sell the shares as your judgment dictates, so as to bring the greatest possible results. I realize that unless you have control over my investment it would be impossible for you to guarantee me against loss."

On the back of this is another form, also addressed to Swoboda, on which the applicant for a share in the promised wealth is induced to affirm that:

"This money is sent to you with the understanding that you guarantee to return it to me, without the loss of a single penny, if you do not raise the entire $150,000, as explained in your letter.

"It is also understood by me that you are making this a strictly Swobodian proposition, and that you are not accepting subscriptions from anyone who has not been your pupil.

"Furthermore, I understand that it is your idea to make this a proposition for those of moderate means, by making up this fund, if possible, without permitting anyone to put in more than $200, as explained in your letter. I approve this plan to help those who need it most.

"I am sending this money to you because you are backing this proposition with your honor, your reputation, your future, your sincerity and your own money.

"It is understood by me that I shall receive stock certificates of the capital stock of the Valenciana Deep Mining Company when this $150,000 transaction is completed."

With unrestricted promotion of this character being carried on in the heart of New York City, is it any wonder that the man in the street considers investment in mining a risky undertaking?

Good Management and Financing Operation

A MINING COMPANY is comparable with a commercial organization in that liquid or available assets in one form or other are essential for the continuation of the enterprise. These may be actual cash in hand, or its equivalent, or ability to command credit. The shrewd manager appreciates the potency of a credit balance and seeks to safeguard immediate demands by building up his credit balance in various ways. In the ordinary conduct of a mining enterprise, after initial financing, the surplus over operating expenses is the vitalizing factor in assuring continuity. This surplus may be accumulated as a cash credit or may be divided, a portion being retained as a cash surplus and the remainder expended in extending ore reserves.

The building up of ore reserves by advance development has the important advantage of giving elasticity in mining operations and insuring production at a predetermined tonnage or poundage of metal. However, it is not always wise too greatly to extend development by ordinary mine openings, as the expense for keeping levels open until they are required for mining may involve a relatively great increase in operating expenses without an equivalent return. Thus, in bad ground only sufficient advance work to explore the possibilities of the deposit at depth may be justified. Under these conditions a money reserve or its equivalent to insure development as it is needed should be carried, in addition to the usual working fund.

We are of the opinion that the working fund available to a manager should be large enough to pay operating expenses for a year at least, and, where advance development is inadvisable beyond a minimum amount, an additional fund that would provide for the opening of another level should be maintained. If the mine earns an operating profit in excess of these requirements, or operating profits have been retained until these funds have accumulated, the surplus becomes available for distribution to stockholders. The more erratic the ore deposit the more necessary does it become to provide these funds.

As an example, the United Eastern Mining Co. records an operating cost of $723,343 for the year 1923. For the same year the company carried $728,528 in investments and $850,148 in working and current assets, or a total of $1,578,678 in realizable funds. Other examples could be quoted, but the principle is clear that good management of mining properties requires the maintenance of sufficient financial reserves or credit to insure continuous operation over a reasonable period.

Small companies and prospects are often seriously handicapped by the necessity of making demands upon stockholders for additional funds, but the financing of operating and development funds is just as important as in the larger companies and good management just as essential.

Germany's Revival

Hope and Financial Soundness Have Replaced Despair and Inflation

By E. J. Mehren
Vice-President, McGraw-Hill Co., Inc.

NO COUNTRY in the world today is, from the economic viewpoint, so interesting as Germany. She occupies the spotlight in Europe. What is to be her future?—is the question that everyone in the old world is asking.

The answer to that question no one can tell. The problem is complicated. But this even the casual visitor to Germany can say: *Germany has made tremendous strides since the war; she is showing extraordinary recuperative power—against tremendous handicaps; she has worked a financial miracle since November of last year; and, finally, no nation that shows Germany's potential strength can be permanently kept down, can be crushed.*

These observations, let me repeat, even the casual visitor must make. The signs are written everywhere: in a people again well nourished, in a public administrative ability (irrespective of party) that was able without new revolution to stabilize the currency, in a returning hope that Germany can again rise. There is not buoyancy of spirit, but there is a deep-founded confidence that the nation is not going to pieces.

The situation is in sharp contrast to what one expects. In America we hear of the wrecking of the currency, of the sufferings of last winter, of the difficulties under which her industries labor in securing raw materials and finding markets. Upon these reports—which, of course, are correct—we paint with our imaginations a country on the verge of despair, a disrupted industry, a tottering government. The surprise is a great one—and, if one is fair-minded, he must come away with deep admiration for what has been accomplished.

Let us briefly paint the picture of Germany's economic circumstances:

Under the Versailles treaty or as a result of it she lost heavily of her iron and coal deposits—in Alsace-Lorraine, the Saar and Upper Silesia; she lost her colonies, her foreign investments, her shipping, her export organization and its connections; she has a large part of her territory under the control of her former enemies. In addition she has been through an exhausting war and a political revolution.

These conditions are not new; they existed when I was in Germany just four years ago, in the summer of 1920. The result was what might have been expected—an under-fed, discontented people, a disorganized industry, and an all-pervading discouragement, unrelieved by any ray of hope.

Since then, since 1920, two other financial disasters have forced themselves into the picture—the occupation of the great industrial district of the Ruhr, and the wrecking of the currency.

With these added calamities one should logically expect that conditions would be worse instead of better, that the despair would be even blacker than before.

And yet conditions are as I have described—immeasurably better. Here is a nation on the up-grade, rather than the down. Here is a nation to be reckoned with economically, not to be ignored; here is a nation that is sure to be an important factor in the world's industry.

This last is a bold statement. I realize what terrific handicaps the rest of the world *can* put upon Germany if it wishes. It *can* keep Germany impotent, but it is my belief that it will *not* do so. Sentiment, moreover, will play no part; commercial considerations alone will lead to trading with Germany. Other nations will want to sell to the markets of a reviving Germany. If they sell to Germany, they will buy from Germany, and if they buy from Germany, a prominent place in world affairs is assured her by the potential strength she is now so conspicuously displaying.

Let it be clearly understood that the path of recovery for Germany is not an easy or a quick one. She is not out of difficulty. The economic handicaps recited above are still upon her; some of them are being slowly removed—such as the absence of shipping and foreign commercial connections; some of them—such as the lack of colonies—may never be removed. But a nation that under present handicaps has recovered as she has done will rise despite the obstacles that a commercially minded world is likely permanently to place upon her.

The Turning Point

The great German economic miracle was wrought in the closing months of 1923 and the early part of 1924. Early last autumn Germany truly, to use the words of Basil Miles, administrative commissioner for the United States in the International Chamber of Commerce, was at the cross-roads. Directly ahead—on the road she was traveling, the road of unbalanced budgets, of state subsidy of the railroads, of currency debasement—was revolution, industrial suicide, destruction. To the right was a stormy path, extremely difficult, beset possibly by disorder, possibly by revolution, but leading, if the difficulties could be mastered, to economic soundness. It was the road of a stabilized currency, with its accompaniments of balanced budgets and governmental economy. Germany chose to go to the right, to take the difficult road, to bear the stress of financial reform and currency stabilization. She did it at a time, too, when the situation in the Ruhr was at its most critical stage, when strong forces were seeking to pry loose the Rhineland and erect it into an independent state, when the attitude of Bavaria toward the rest of Germany was much in doubt. But she went on, nevertheless. The government declared that the mark should be stabilized at four trillion 200 billion to the dollar. There was a severe contest with the mark speculators, but by severe measures the government won, and since November, 1923, legally, and about Jan. 1, actually, the rentenmark has stood at 23.8c. to the dollar. There was no revolution.

Germany *is* beyond the cross-roads and has chosen rightly. The future is long and difficult, but there is health where there was disease, there is hope where there was despair.

Let me now add some details—briefly. They will help to an understanding of the situation. Each item deserves elaboration, but that would take much space.

The severest present industrial handicap is lack of credit. The great credit reservoirs were nearly or entirely wiped out by the fall of the mark. Further, there was no incentive to save; industries and individuals converted the tobogganing mark into goods as quickly as possible. Today the credit resources of the banks are estimated at one-tenth the pre-war amount. When credits are obtained the interest rate is 2½ per cent per month for the very best security.

There is a terrific money shortage, which also curtails business, for with lack of credit everyone tries to insist on cash on delivery.

Wages are at approximately pre-war level. Prices, as of July 15 (according to the *Frankfurter Zeitung* index, the highest index I could find and which takes in ninety-eight commodities) are 34 per cent above 1913. (The government's index for wholesale prices is 12 per cent above 1913.)

Efficiency of labor has increased notably and is still increasing. *I heard no general complaint against the working man in Germany as I did in England.*

Unemployment, while fairly large just now, is not as great as that of Great Britain, and does not present the all-engrossing problem in Germany that it does in the British Isles.

The works councils, elected by the workers, are said by the employers to be a good influence. They help smooth out difficulties and, in general, have not been radical.

Hours of work per day are increasing.

The coal supply, which by its shortage was expected to be for many years a serious handicap to German industry, is now more than ample, on account of the very large development of lignite deposits.

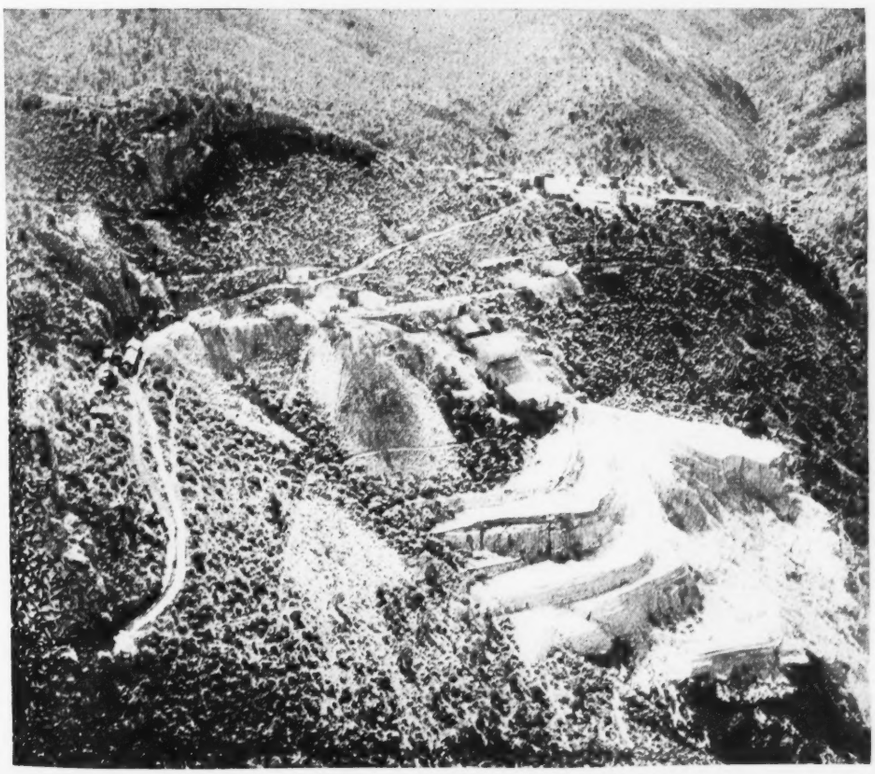
The heavy taxes imposed on industry and individuals are beginning, under the stabilized rentenmark, to yield a good revenue. Recent figures show a surplus that has been used to retire obligations.

There is much more to be said and the details just given need elaboration. But these few particulars will help to fill out the picture as I saw it—the picture of an industrial nation again on a sound basis, well organized, confident that somehow it will work out its difficulties and play a part in the world of industry and commerce.

Berlin, Aug. 13, 1924.

Mogollon, New Mexico, from the Air

The camp of Mogollon in its cañon setting in western New Mexico, 80 miles north of the railroad at Silver City



Cyanide plant and settlement at the Mogollon Mines Co.'s Fannie mine, at Mogollon on the mountain side above the cañon

Mine Managers of Note

Howard I. Young

BY WHAT ROUTE does a man arrive at success? On the way in which it answers this question depends much of the interest that a biographical sketch possesses. The succession of positions occupied resembles the succession of sign posts along a traveled road—with this difference: the former do not tell the would-be traveler how to reach the desired destination. It is this elusiveness of the formula sought for that fascinates the reader. Besides, conditions and factors influencing a career differ with the man; the handicaps and advantages are variable. An interesting career is that of Howard I. Young, manager of mines for the American Zinc, Lead & Smelting Co. Sixteen years ago, at the age of nineteen, he entered the company's employ in a clerical capacity in the accounting department in its Carterville, Mo., office. Today at thirty-five he is manager of mines for the company, in charge of its operations in Tennessee, Montana, Missouri, and Wisconsin. All this Young has accomplished without ever setting foot in a technical school, his early education having been obtained in the local schools of the Joplin district and in Springfield College, Missouri, where he took a commercial course. What have been the factors that have determined his success? Is it that "Lady Luck" has played a great part in his mining career, as he modestly states? "First," he says, "it has been the policy of my superiors to promote men from within the ranks and at all times to afford the opportunity to those interested to learn the full details of the operation. Second, I have always had the loyal support of our entire organization." His associates are more outspoken. The qualities to which they ascribe his rise are his personality, his energy, his industry, and his integrity, and no mention is made of luck. He has, they say, the happy knack of selecting the right men and of leading them in the work to be done. His energy and industry are abundant. While the operations of the American Zinc, Lead & Smelting Co. were the center of his interest during the entire period of his Joplin experience, he nevertheless found time to manage several other local properties, the most important of which was the Woodchuck Zinc & Lead Co., of which he had charge for approximately two years. It is interesting to note that Young has risen through the accounting department and not through the engineering office—a circumstance worthy of serious consideration. Then, too, he is a product of the Joplin district, and his selection as manager for the American Zinc company's mines seems natural and and fitting. His first introduction to mining was through loading and hauling concentrates during his vacation when fourteen years of age. During later vacations he broadened his acquaintance with the industry through the use of a long-handled shovel in crusher feeding and by other varied work at a mine plant near his home. Upon leaving school he worked for a time at a zinc mine, where he was in charge of accounting and purchasing, and then for a company near Carthage making mining and quarrying machinery. Here he was in charge of the office until July, 1908, when he left to go with his present employers. A year later he became head of the accounting department, acting in this capacity until 1914, when he was made manager of the company's Missouri operations. At this time the sheet-ground section of the Joplin district was the source of most of the district's output and the American Zinc company's mines were the largest in that important area. It was the experience gained in operating these low-grade mines and the broad-minded policy of his supervisors, permitting access to all operating data, that laid the foundation for his present success. During this period it was Young's privilege to be in frequent association with the older operators of the district in matters of common interest. He served as first president of the Southwest Missouri Safety and Sanitation Association, and as a member of a committee of three that worked out the program that resulted in the organization of the American Zinc Institute, of which he is treasurer. In 1919, he was advanced to the position of manager of all of the company's mines, with headquarters at Mascot, Tenn., where he makes his home.

HOWARD I. YOUNG

Mining Zinc at Mascot

A Sketch of the Operations of the American Zinc Co. of Tennessee, Including Its Limestone Plant

By A. H. Hubbell
Managing Editor

AT MASCOT, 14 miles east of Knoxville, Tenn., the American Zinc Co. of Tennessee has built up a remarkable organization for working the zinc deposits of the district. The visitor is at once impressed by the unexpected size and diversity of the operation as well as by the results obtained.

Few facts are readily available as to the early history of the district. The occurrence of zinc ores at Mascot has been known for years. Among the early operators was the Roseberry Zinc Co., which in 1903 erected the first mill. The following year the Holston Zinc Co. built a concentrator on the tract where the present plant is situated. In 1908, the district was brought to the attention of the American Zinc Co., and in the latter part of 1910 drilling was begun. Two years and a half of prospecting and development work ensued, and in 1913 the present mill was built and operations were started. The results of the company's efforts in the eleven years since elapsed will be told briefly in the following sketch, which is based upon a recent visit to the camp, and upon data furnished by the company through its general manager, Howard I. Young, and his staff.

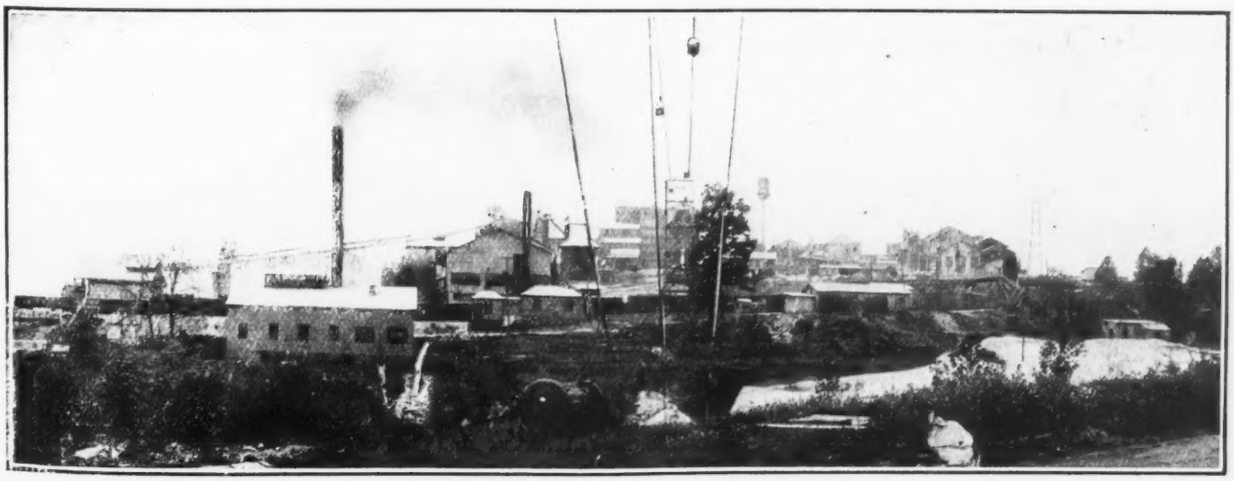
About 3,200 acres is owned by the company, most of which may be considered to have mineral possibilities. Through the tract passes the main line of the Southern Railway, running from Knoxville northeast. The country is well watered, fertile, with considerable second-growth timber standing, and is valuable for agricultural purposes. The climate is moderately warm in summer and mild in winter. Farming is an important industry. A novel feature of the camp is the company's 1,000 acre farm, which is included in its holdings. Of this more will be said later. It is mentioned here merely to point out that at Mascot mining is associated with neither desert nor desolation—something that a mining camp often cannot boast.

Mascot, in fact, is a very livable place. Its good features are many; it is near a large city, and besides the railroad an excellent automobile highway links the place with Knoxville. The local grade school and high school are good, thanks to the company's co-operation with the county. The camp's infant mortality rate is the lowest in the state—a record due to a water supply filtered and sterilized by the company, a milk supply from the company's farm tested weekly in the company's laboratory—along with samples of zinc ore and concentrates—and to the company's hospital service and its doctor and visiting nurse. Mascot is also clean, physically and morally, thanks to careful though inconspicuous supervision. Its employees are well housed in company houses, and its staff and their families are excellently taken care of at Holston Hill—an attractive bungalow settlement in the woods above a creek within a furlong of the plant. All these things that make the camp a desirable place in which to live—and to visit—also are to some extent reflected in the results gained by the management, which has not neglected the human engineering factors in its attention to mining and milling details.

Sulphide Orebodies in Knox Dolomite

The Knox dolomite, which has a thickness of several thousand feet, forms the country rock throughout this region. It is composed of a series of dolomite and limestone beds with some flint. The ore is sphalerite, or zinc sulphide, which is here found as a light-colored blende that is lead-free. The geology of the district and of the ore deposits is tersely summarized in the following brief description, which has been written for this article by the company's geologist, M. H. Newman:

"Folio No. 75 of the U. S. Geological Survey covers the general geological feature of the quadrangle in which the Mascot mines are situated. The ore-bearing formation in

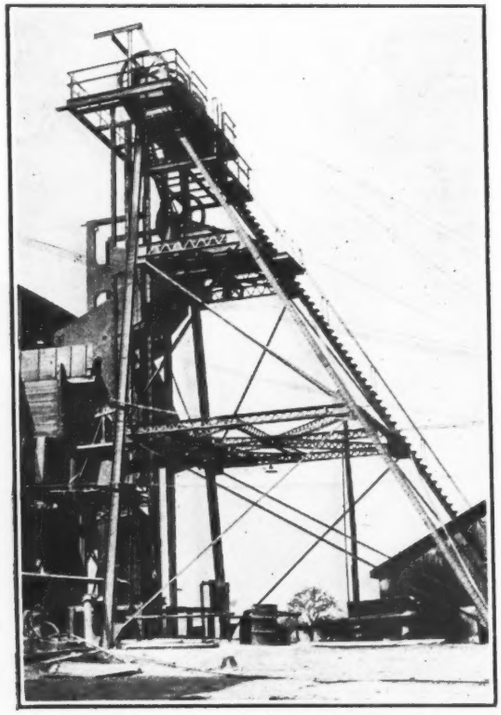


Concentrator of American Zinc Co. of Tennessee, at Mascot, from the Southern R.R.

Panorama of the property of the American Zinc Co. of Tennessee at Mascot from a point near No. 4 shaft. Le

that report is designated as the Knox dolomite and is referred to Cambro-silurian age. High magnesium limestones predominate. These, together with limestone of lower magnesium content and flinty limestones, bring the thickness of the Knox series to a total of upward of three thousand feet. The Mascot orebodies occur at a point near the bottom of the upper third of this series. The structure in the immediate area of the mines is monoclinal—the strike of the formation bears somewhat north of east and the dip varies on the average between 15 and 25 deg. to the south.

"The breccia with which the ores are associated occupies an horizon within this structure, and in a general sense conforms to the strike and dip of the inclosing beds. The bottom of the breccia is fairly well marked by a series of brown limestone beds or by their metamorphosed equivalents. The top of the breccia is less constant in horizon than the bottom. Laterally, the degree of brecciation is quite irregular and, in places, continuity in the sense of true breccia appears to be lacking altogether. From a general viewpoint, the persistence of the brecciated horizon may be said to be remarkable—in detail, the degree of brecciation within the horizon is quite variable.



Headframe at No. 1 shaft, 65 ft. high

"The orebodies, while large, follow irregular and sometimes quite tortuous courses within this brecciated horizon. The bottom of an orebody usually is marked by a rather sharp cutting out of values along some bed of metamorphosed brown lime. The top of an orebody is usually that point where decreasing values dictate that mining shall cease. In exceptional cases, thicknesses of 100 vertical feet or more of ore have been mined between bottom and top as above. The sides of an orebody are usually marked by the giving out of values in localities of decreasing brecciation.

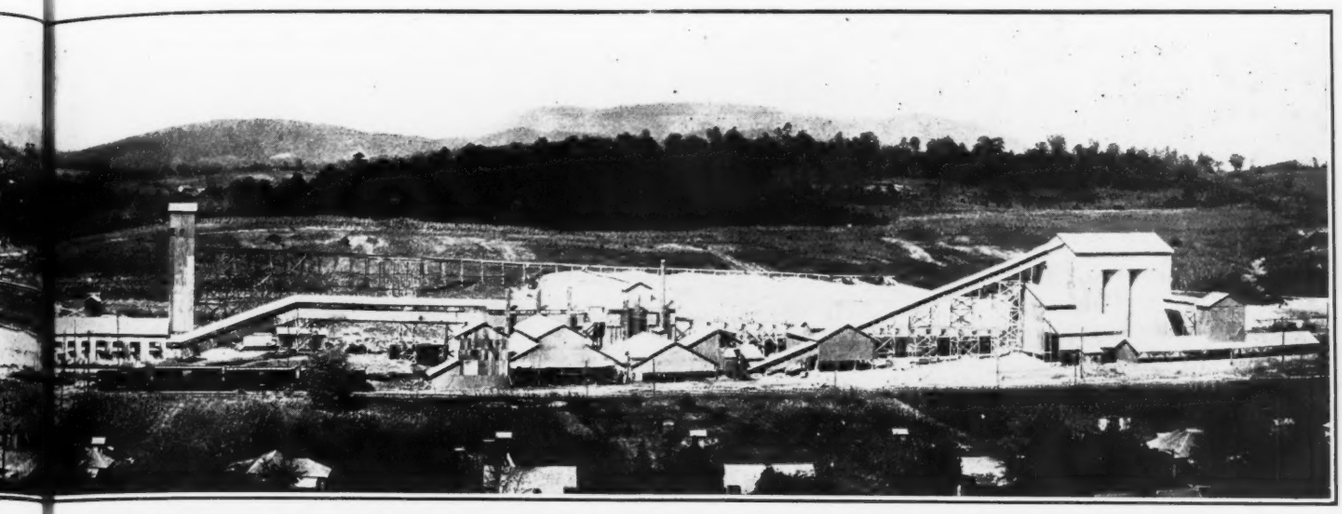
"The ore mineral is zinc blende. Its more important occurrence is with secondary dolomite within the interstices of the brecciated fragments, though it appears also to a less degree as replacement of dolomite within the metamorphosed equivalent of brown limestone beds."

Mine Workings Extensive

The mine workings, old and new, are in four groups, known respectively in order of their position from west to east as No. 3 mine or shaft, No. 1 mine, No. 2 mine, and No. 4 mine. The bulk of the ore comes from No. 1 and No. 2. From the west side of No. 3 workings which is the extreme west end, to No. 4 shaft on the east is about 8,400 ft. The workings are connected from one end to the other. From No. 4 mine to No. 2 shaft it is 4,000 ft.

No. 2 is the company's principal mine, and produces at present about 8,500 tons per six-day week of ore running 3.4 to 3.5 per cent zinc. It is connected with the mill at No. 1 shaft by a 2,000-ft. Bleichert tramway. No. 1 mine is second in importance, and its ore is much lower in grade. Its output per six-day week is 5,000 tons. A 50-per cent extraction is made on this low-grade ore from No. 1, against 85 per cent on the richer ore from No. 2. The reason for milling the low-grade ore is that the company can make profitable use of the tailing, which, with the other tailing, is sold for railroad ballast, or for making concrete, or is converted into agricultural limestone at the company's limestone plant near by. These byproducts are quite important as a source of profit. As it is, 80 per cent of the low-grade ore hoisted from No. 1 goes into the tails and 50 per cent of that from No. 2.

No. 3 mine, the most westerly workings, is 3,200 ft. by the haulage road from No. 1 shaft. Its history is that of a "war baby." In importance today it is practically equivalent to a stope of No. 1. Ore from it is hoisted through No. 1 shaft. Ore from No. 4, which is under development, will be handled through No. 2 shaft.



Left background (page 408), the mill at No. 1 mine. On this page, the limestone plant

Owing to the extent of the workings, artificial ventilation is employed. It is effected in No. 2 mine by a No. 9 Buffalo Forge Co. conoidal fan, installed at No. 4 shaft. This is designed to supply 35,000 cu.ft. of air per minute, which is boosted to 45,000 cu.ft. The fan is made reversible in the ordinary fashion—that is, the direction of the air current may be reversed by means of doors, so as to keep No. 2 shaft upcast in winter. No. 1 shaft is upcast all the year round. A similar installation at No. 3 shaft ventilates No. 1 mine.

No. 1 shaft is 275 ft. deep and has three compartments—two skipways 5x5½ ft. and one compartment 3 ft. 1 in. by 5½ ft. for the cage, with additional space for pipes. It is concreted to a depth of 26 ft.

No. 2 shaft is 517 ft. deep and has four compartments, two 5x5½-ft. skipways and one of the same inside dimensions for the cage; also one 3x5½-ft. pipe and man way. It is concreted to a depth of 47 ft.

To facilitate the extraction of the ore opened below the 520 level in No. 2 mine, a 614-ft. incline has been sunk on a 21-deg. slope. It is used for hoisting ore to the 520 level from the 635 and 735 levels. A Wellman-Seaver-Morgan drum hoist handles four 1.7-ton cars per trip on this incline. A 150-hp. motor with double reduction gears operates the hoist. A 1-in. 6x19 plow steel rope is used.

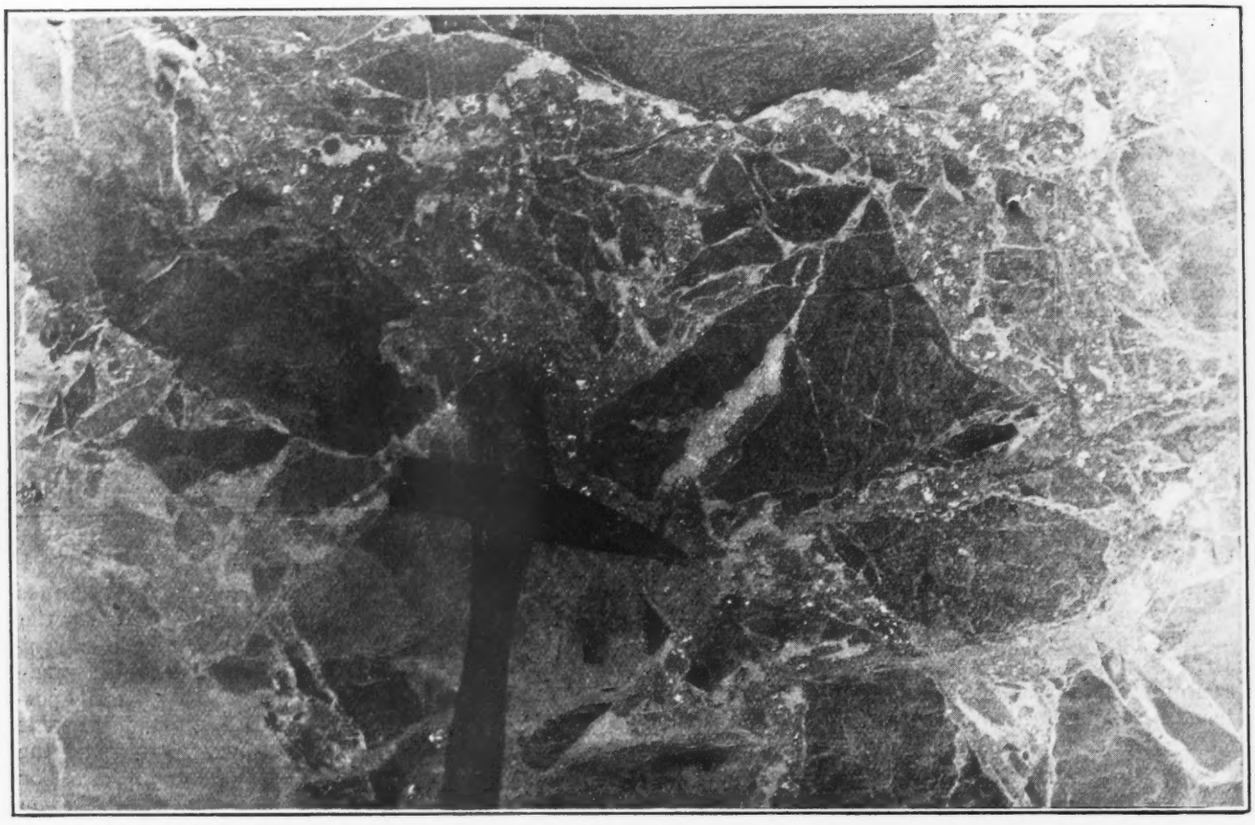
Both shafts have steel headframes—that at No. 2 being 72 ft. high and that at No. 1, 65 ft.

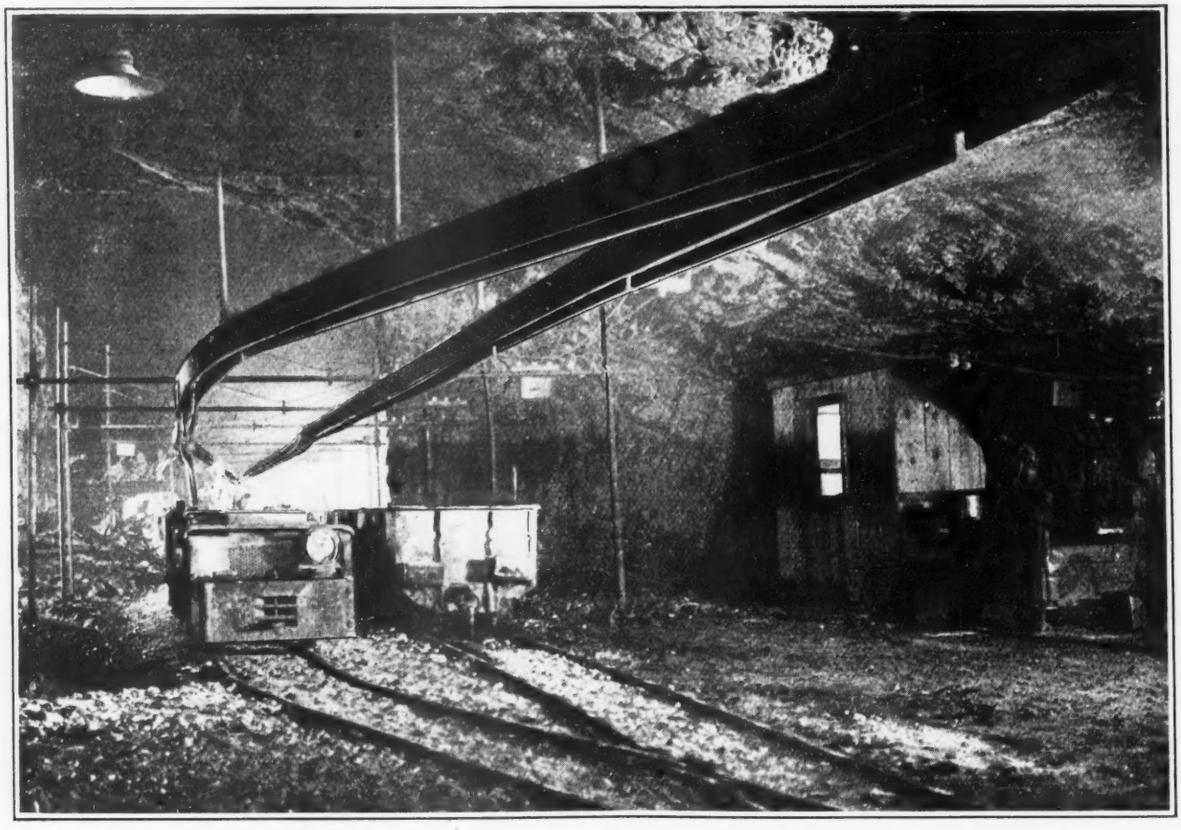
Ore Mined by Two Methods

Two methods of mining are in use underground; one method, the older of the two, involves the breaking of ore in open stopes by a "cutting in and bench"—that is, by raising through the ore to what is assumed to be the hanging (because of its barrenness or decreased zinc content) and then driving a heading beneath this back and underhanding out the resulting bench, leaving pillars where advisable. This method was used entirely in the past, and at the present time (taking a typical week's results) yields about 38 per cent of the total tonnage broken.

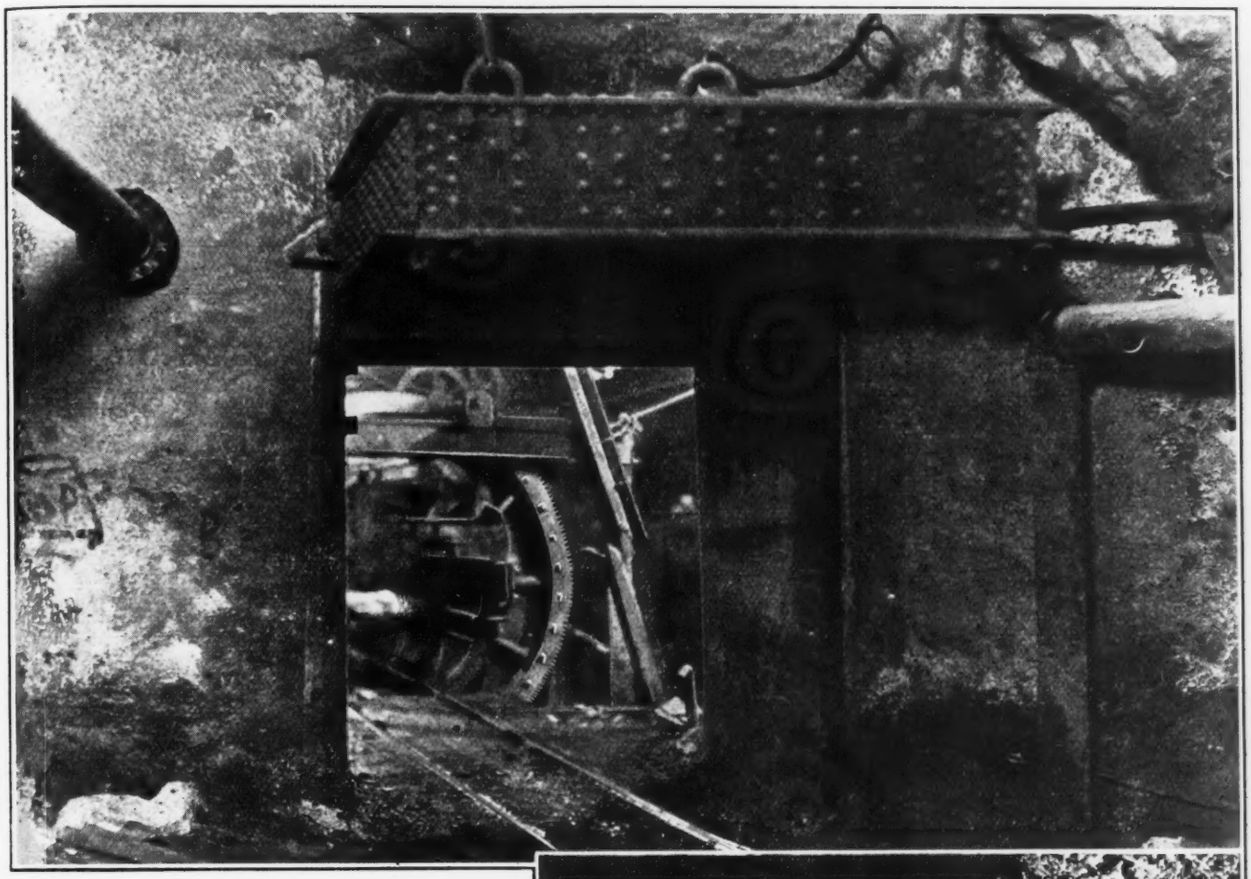
Under the second method, underground glory holes or mill holes are employed. In the recent typical week mentioned above, 57 per cent of the tonnage was thus broken. Neither of these methods involves the use of timber. The mill-hole raises are driven 5x5 ft. and then reamed to 10x10 ft., the loading chutes having 48-in. lips. The efficiency of the mill-hole method depends largely on the skill used in selecting the points for the mill holes at the start. An endeavor is made to spot them so that 45,000 to 60,000 tons of the proper grade of ore can be drawn from one point. This is made possible through thorough drilling of the ground. As this method has been worked, the company has found the average mill hole to be good, as a source of ore, for two and a half years on the average, and some of them have lasted as long as three years. The method does not give the chance of selecting the ore to be broken that the open-stope method affords. Because of this and, further, because of the position of the orebody (dipping gently or almost flat in places), the open-stope method will probably continue to be used for breaking 20 to 25 per cent of the tonnage. The ability to select a certain amount of the ore to be broken is necessary

Headframe at No. 2 shaft, 72 ft. high





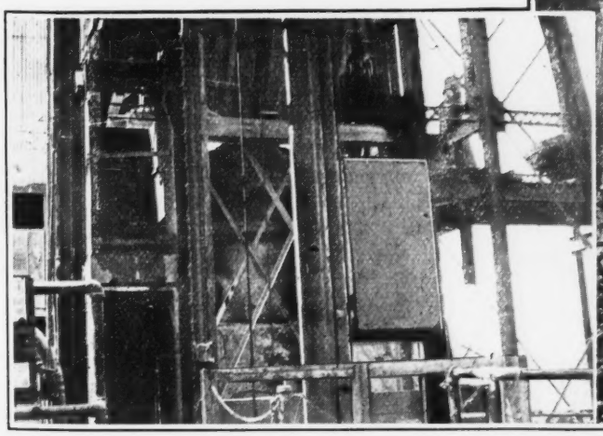
Above—Typical ore formation in heavily brecciated ground in No. 2 mine of American Zinc Co. of Tennessee, Mascot, Tenn. The ore is zinc blende, the ore-bearing formation being the Knox dolomite (see pages 407-408). Below—Part of the trolley haulage system recently installed on 520 level of No. 2 mine to supplement the storage-battery locomotives and mules already in use



Above—Bulkhead construction in No. 2 mine, just ahead of the two-car electrically-operated tipple over the 750-ton skip pocket

Right—Type of chute used for loading ore broken by the mill-hole or glory-hole method of mining

Below—A skip at No. 1 shaft almost ready to dump. The gyratory crusher can be seen through the adjoining compartment



Loading terminal of Bleichert tramway at No. 2 shaft, which carries the ore to mill at No. 1 shaft

if the mill heads are to be maintained at a fairly uniform figure. In a paper on the mining methods used, which H. A. Coy, the mine superintendent, has prepared for the fall meeting of the Institute, the practice under both methods is described in detail.

Accidents underground are rare. During 1923 the ratio was 0.68 accident per 1,000 man-hours worked in the mine.

By reason of the methods of mining employed there are no reserves of broken ore. The company does from 125 to 150 ft. of drifting and raising per week and by this policy keeps enough ore for several years' stoping opened up ahead. In the typical week twice referred to thus far, 5 per cent of the tonnage broken came from development work.

Contracting Customary Underground

Practically all ore is broken on contract at a fixed amount per ton. In the typical week, 94 per cent of the entire tonnage was thus broken, leaving only 6 per cent to be mined on company time. In the open stopes, the miner-contractors are required to furnish all labor, powder, fuse, caps, and wrenches used in stoping and the labor and explosives needed in block-shooting boulders for the shovelers. They must also keep their roof in safe condition. The company, on its part, furnishes all drilling equipment, drill steel and air hose; also all power, oil, tamping poles, and carbide. It also furnishes repairs for all equipment save Stillson wrenches. In the mill holes the contracts are the same as for the open stopes except that the contractor pays for the chute pullers who load the cars and tram them to the nearest lay-by. This method of payment is giving excellent results both to the company and the men.

In an effort to reduce the variety of equipment used the company is standardizing on the following machines for drilling:

General stoping—Denver Rock Drill Dreadnaught 60.
Drifting—I-R water Leyner, 248.
Blockholing—I-R, BCR 430 Jackhamer.
Raising—I-R, BC 21 dry hand rotating stoper.

One-inch five-ply Goodyear air hose is used for all work except in high raises, where ¾-in. hose is used. The air at the drills is about 82-lb. pressure.

For drifting and general stoping 1¼-in. round hollow lug steel is used. This is annealed at the steel mill to resist breakage. For the Jackhamers, ⅞-in. hollow hexagon steel is used. The stopers are using 1-in. cruciform steel. All sharpening is done underground in No. 1 and No. 2 mines, each shop being equipped with a No. 5 I-R sharpener and an oil-fired forge. Tempering is done in water and oil.

Economy in the use of explosive usually results from making the contractor pay for his powder. This is well illustrated at Mascot. The only explosive used is 30 per cent Atlas LF (low freezing) gelatin, in 1⅛x8-in. sticks. This is extra plastic gelatin, and comes in a white wrapper which is chemically treated by the manufacturer to get rid of paraffine so as to reduce the fumes. An old rule of thumb calling for a stick of powder for every foot of hole is followed by the miner, but now that the contractor pays for the powder it is followed in a somewhat different way. He plans his round—a standard round of six 8-ft. holes—so as to get the maximum breakage for a given amount of powder. He knows the depth of hole and uses one stick of powder per foot. Then he spots his holes so that the burden will be no greater than his experience has taught him this given amount of powder will break. The powder is his first consideration.

Three Haulage Methods Used

Both mules and storage-battery locomotives have been used for hauling. In addition, trolley haulage has recently been installed. All three systems will continue to be used. Cars are gathered from the loading places and taken by mules to lay-bys. From the lay-bys storage-battery locomotives have been used to pull them to the tipple. A four-ton General Electric locomotive and a six-ton Jeffrey locomotive have served for this work, in addition to a four-ton Jeffrey at the tipple. Each G. E. set has sixty-three A6 Edison cells, with two sets to each General Electric locomotive. The Jeffrey locomotive uses seventy A12 Edison cells. At No. 2 shaft there is a charging station with a 40-kw. Westinghouse motor-generator set. It comprises a 125-volt, shunt-wound, 1,200-r.p.m. generator and squirrel-cage motor, 2,300 volts, 3 phase, 60 cycles. The locomotive batteries in No. 1 mine are charged from the 300-hp. motor-generator set there that is referred to on page 413.

The reason given for installing trolley haulage is that the economic limit for storage-battery haulage has been reached, in these workings at least. The maximum haul from tipple to stope in No. 2 mine is now 3,000 ft. and it is also planned to haul from No. 4 mine to No. 2 shaft, the total distance being 4,000 ft. Hence the trolley haulage has been provided on the main 520 level of No. 2 mine. A seven-ton General Electric trolley locomotive is rendering the new service. It is provided with a reel for gathering from the lay-bys in crosscuts already established for storage-battery haulage. A General Electric synchronous rotary converter is used to provide direct current for the trolley circuit. It is a 100-kw. 275-volt d.c., 1,200-r.p.m. machine, the primary voltage being 2,300.

Tipples Used for Dumping Cars

All-steel 40-cu.ft. mine cars, without doors, are used throughout the workings except on the only two sublevels in the property, on which old 1¼-ton end-dump steel cars are employed. These sublevels are being cut out as fast as possible. The 40-cu.ft. cars are made

in the shops and are equipped with Whitney Wonder trucks. Hoisting records over a period of years show that the actual average load per car is 1.7 tons. Cars are dumped by electrically operated tipples into 750-ton skip pockets in which no grizzlies are used. No. 2 shaft has a two-car tipple; that at No. 1 handles one car at a time. The track gage in No. 2 mine is 24 in.; that in Nos. 1 and 3 is 20 in.

Ore is loaded directly from the pocket into the skips. Two parallel loading chutes of steel are used. These are 40x30 in. at the lip and gradually increase in size for a distance of 6 ft. At this point they meet in the center, making one large opening 10x10 ft. where they join the skip pocket. The flow of ore in each chute is controlled by a set of five fingers made of 2⅛x3⅛-in. cold-rolled shafting. This finger gate is opened and closed by an overhead air cylinder operated by a three-way valve which is located between the two skip compartments on the side of the shaft opposite the chute.

Hoisting is done at both No. 1 and No. 2 shafts in five-ton balanced skips, the actual skip load averaging 3.8 tons. American Steel & Wire Co. plow-steel ropes are used, 1⅛ in. 6x19 on the skips and 1 in. 6x19 on the cages. A double-deck cage is used in both shafts for moving men. All hoisting is done at 500 ft. per minute. The hoisting equipment used is as follows:

Mine No. 1

Skip hoist: Wellman-Seaver-Morgan Co. single straight drum; hoisting two five-ton skips in balance; 1⅛-in steel cable; rope speed, 500 ft. per minute; compressed air operated brake. Hoist is driven through a single-reduction herringbone gear by a 175-hp., 450-r.p.m., 230-volt, direct-current Westinghouse motor

Cage hoist: Wellman-Seaver-Morgan Co. single straight drums, hoisting double-deck cage that is counterweighted; 1-in. steel cable; rope speed, 500 ft. per minute, hand-operated brake. Hoist is driven through single-reduction herringbone gear by a 65-hp., 600-r.p.m., 230-volt, direct-current Westinghouse motor.

Direct current for hoist motors is supplied by the following General Electric motor-generator set:

Synchronous motor 300 hp. 2,200 volts, 60 cycles, 3-phase, Type ATI; speed, 720 r.p.m.

Direct-current generator 200 kw., 250 volts, type D.M.C.; speed, 720 r.p.m. Compound wound.

Mine No. 2

Skip hoist: Nordberg Manufacturing Co. double conical drum; hoisting two five-ton skips in balance; 1⅛-in. steel cables; rope speed, 500 ft. per minute; oil-operated brake. Hoist is driven through single-reduction herringbone gear by a 200-hp., 360-r.p.m., 2,200-volt, 3-phase, 60-cycle, wound-rotor General Electric motor.

Cage hoist: Nordberg Manufacturing Co. single straight drum; hoisting double-deck cage that is counterweighted; 1-in. steel cable; rope speed, 500 ft. per minute; oil-operated brake. Hoist is driven through a single-reduction herringbone gear by a 75-hp., 450-r.p.m., 2,200-volt, 3-phase, 60-cycle, wound-rotor General Electric motor.

All the hoists have air-brake contactors, controlled by means of master controllers, with the usual safety and overwind features.

The compressor plant is at No. 1 mine near the mill and principal shops. Two Ingersoll-Rand 1,750-ft. compressors and one 3,400-ft. Nordberg furnish air at 90 lb. (on top), the line drop giving 82 lb. at the drills. Compressed air is used for ventilation in development work only. Details of the compressor equipment are:

Two Ingersoll-Rand compressors; class P, two-stage, 1,750 cu.ft. free air per minute at 100-lb. gage pressure. Size, 15¼x25¼x21 in. Each is direct connected to a 310-hp., 164-r.p.m., 2,200-volt, 3-phase, 60-cycle synchronous General Electric motor.

One Nordberg Manufacturing Co. compressor, Corliss valves, two-stage, 3,400-cu.ft. free air per minute at 100-lb. gage pressure. Size, 19x32x32 in., direct-connected to a 695-hp., 120-r.p.m., 2,200-volt., 3-phase, 60-cycle synchronous General Electric motor.

Through the camp and directly over the workings of

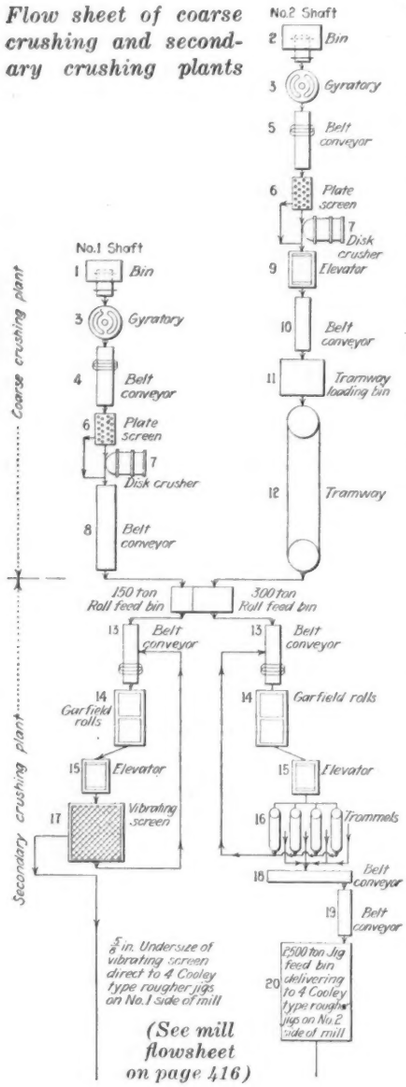
The bed of Holston Creek has been concreted to protect the mine workings

No. 1 mine a creek flows. In 1915 it flooded No. 1 mine. As a result the bed of the stream was concreted (described by H. A. Coy, in *Engineering News-Record*, June 20, 1919.) Since then no further trouble has been experienced from this source. The concreting is shown in the accompanying photograph.

The average normal flow of mine water is greater in winter than in summer, owing to the heavier rainfall. The yearly average of No. 1 mine is about 650 gal. per minute and for No. 2 about 850 gal. Water from No. 1 mine is used in the mill and for the fire lines and miscellaneous plant uses. Provisions made for handling the mill water supply are indicated in the mill flow sheet on page 416. The principal pumps used in the mines and mill are given in the following table:

No.	Name	Type	Size	G.P.M.	R.P.M.	Head	Application	Motor H.P.	Speed	Voltage
1	Goulds	Triplex	10 in. x 16 in.	650	42	560	Mine No. 2 pumping	100	514	2,200
4	Jeanesville	3-stage turbine	6 in.	1,000	1,800	560	Mine No. 2 pumping	200	1,800	2,200
2	Jeanesville	3-stage turbine	6 in.	1,000	1,800	433	Mine No. 1 pumping	200	1,800	440
1	Prescott	Duplex	8 in. x 18 in.	750	48	433	Mine No. 1 pumping	100	720	2,200
2	Layne & Bowler	7-stage turbine	24 in.	2,200	1,200	433	Mine No. 1 pumping	300	1,200	2,200
1	Prescott	Duplex	13 in. x 18 in.	2,000	48	...	Mill make up water	100	600	2,200
1	Prescott	Duplex	13½ x 24 in.	2,500	48	...	Mill return water	100	600	2,200
1	Goulds	Triplex	14 in. x 12 in.	1,000	42	...	Mill return water	35	900	2,200
7	Wilfley	Centrifugal sand	4 in.	500	1,000	Various	Sand and slime pumping	25-75	1,200 720	2,200

Flow sheet of coarse crushing and secondary crushing plants



Coarse Crushing Plant Equipment

1. Twenty-ton bin receiving mine-run ore from 5-ton balanced skips at No. 1 shaft. Stephens-Adamson 42-in. pan feeder, ratchet and pawl drive, 9 ft. per min.

2. Forty-ton hopper receiving mine-run ore from 5-ton balanced skips at No. 2 shaft. Stephens-Adamson 42-in. pan feeder, ratchet and pawl drive, 9 ft. per min.

3. Chalmers & Williams No. 8 bronze ball gyratory crusher, crushing to 4 in., 145 r.p.m.

4. Goodyear 30-in., 5-ply Bluestreak belt conveyor, 20 ft. long, 5½ ft. rise, speed 346 ft. per min. Equipped with 54½-in., No. 4 type SA lifting magnet made by Electric Controller Co., 27 amp. 220 volts.

5. Goodyear 6-ply, 30-in. Bluestreak belt conveyor, 28 ft. long, 9½ ft. rise, speed 336 ft. per min. Equipped with SA lifting magnet similar to that of No. 4.

6. Manganese steel plate screen, sloping 45 deg., ½ in. thick, 36x96 in., punched with 2-in. round holes.

7. Chalmers & Williams 48-in. horizontal style C Symons disk crusher, maximum opening 1⅞ in.

8. Goodyear 6-ply, 30-in. Cougar belt. Inclined conveyor, first 52 ft. rises 13 ft.; remaining 107 ft. rises 29 ft. Speed 310 ft. per min.

9. Goodyear 22-in. Compass elevator. Steel buckets spaced 16 in. c. to c., 446 ft. per min., 55 ft. high.

10. Goodyear 30-in. 6-ply Bluestreak horizontal conveyor, 14 ft. long, 330 ft. per min. Delivers to center of storage bin.

11. Three-hundred-ton storage bin for tramway loading, equipped with four arc gates on each side for hand-loading tram buckets. Bin 28x30 ft. and 28 ft. deep.

12. Bleichert tramway. See text on this page.

Secondary Crushing Plant Equipment

13. Two Goodyear 6-ply, 24-in. Bluestreak conveyors, inclined; 50 ft. long, rising 11 ft. Speed 350 ft. per min. Equipped with lifting magnet like that of No. 4 and No. 5 above.

14. Two sets Power & Mining Machinery Works 54x20-in Garfield rolls, manganese steel shells, 92 r.p.m.

15. Two Goodyear 22-in., 7-ply Compass elevators; 22-in. steel cups, 16 in. c. to c.; 63 ft. high, 425 ft. per min. Dia. H.P. 54 in. Dia. B.P. 24 in.

16. Four 48x96-in. trommels, ⅝-in. round holes, 15 r.p.m., sloping 1½ in. per ft.

17. No. 2 type Mitchell vibrating screen, 48x72 in., No. 9 wire, ⅝ in. opening.

18. Goodyear 24-in. 6-ply Bluestreak horizontal belt conveyor, 68 ft. long, speed 314 ft. per min.

19. Inclined Diamond conveyor belt, 24-in., 6-ply; Link-Belt hand-propelled tripper for distribution in bin. First 55 ft. rises 20 ft., remaining 54 ft. horizontal. Speed 330 ft. per min.

20. Storage bin; flat bottom, equipped with fourteen oscillating tray feeders; 28 cuts per min. Bin 30x60x24 ft. deep.

Tramway Conveys No. 2 Ore to Mill

Ore from No. 2 shaft, after being crushed to 1⅛-in. size in the coarse-crushing plant at the collar, is delivered to the 300-ton storage bin of the tramway loading terminal, immediately adjacent, for transportation to the mill. This is a Bleichert-type tramway, 1,850 ft. long, the discharge terminal being 80 ft. higher than the loading end. With eighteen buckets on the line (nine each way) it handles 128 buckets per hour, each bucket holding 1,600 lb. of ore and traveling 506 ft. per minute. Cables of cast crucible steel are used, the traction cable being ⅝ in. Lang lay, and the load and return tracks being 1½-in. and 1-in. locked-coil ropes respectively. The buckets are loaded and dumped by hand, requiring two men at each end, so that the labor cost is rather high. The tramway is worked two shifts and part of the third.

Ore storage capacity totals 3,210 tons. It is distributed thus (not including skip loading pockets):

	Tons
Hopper into which No. 1 skips dump	20
Hopper into which No. 2 skips dump	40
Tramway loading terminal bin	300
Roll feed bin, No. 1 ore	150
Roll feed bin, No. 2 ore	300
Jig feed bin, No. 2	2,500
	3,310

Jigging and Flotation Employed

Treatment of the ore on the surface consists, to sum it briefly, in reduction in two stages to 1⅛-in. size by gyratories and horizontal disk crushers in the coarse-crushing plants at No. 1 and No. 2 shafts; further reduction to ⅝ in. by rolls in the secondary crushing plant at the mill; and then jigging, without other preparation, followed by fine grinding and flotation of the jig middlings. The tailings of the bull and rougher jigs are not floated. Being coarse, they are suitable for railroad ballast and road material, and are sold for such. The flotation tails are converted into agricultural limestone in the company's limestone plant close by. About 30 per cent of the total concentrates comes from the jigs and 70 per cent from flotation.

Details of crushing and milling are given in the flow sheets on page 414 and 416. These flow sheets, with the flow sheet of the limestone plant on page 417 are adapted from one prepared by the mill superintendent, Robert Ammon, for a paper on the milling methods, which has been written for the Institute's fall meeting. In the accompanying tabular matter on pp. 414, 416 and 417 will be found additional data as to equipment used.

In the fine-grinding plant, it will be noted in the flow sheet (p. 416), the two Dorr classifiers are arranged to work in closed circuit with any number of the five mills. Customarily four of the mills are operated with one of the classsifiers. The product of the fine-grinding plant is 20 per cent plus 100 mesh.

Reagents added per ton of dry feed in the flotation plant are: ¼ lb. pine oil; $\frac{1}{10}$ lb. copper sulphate; and $\frac{1}{10}$ lb. thiocarbanilid. The average consumption of reagents in 1923 per ton of dry slime floated was 0.365 lb. pine oil, 0.363 lb. copper sulphate, and 0.176 lb. thiocarbanilid.

Excellent results are obtained in milling, especially in the flotation department. The following figures are averages for 1923:

	Per Cent Zinc
Jig tailings, No. 1 ore (low-grade)	0.71
Jig tailings, No. 2 ore	0.85
Flotation tailings	0.09
Jig concentrates	60.80
Flotation concentrates	60.55

Total concentrates	25 per cent made on jigs, 75 per cent in flotation
Total concentrates shipped	1.3 per cent Fe and 2.09 per cent CaO
	Per Cent
Flotation recovery	98.14
Total recovery on No. 1 ore	50.92
Total recovery on No. 2 ore	86.31
Flotation feed	17 per cent plus 100 mesh 54 per cent minus 200 mesh
Flotation concentrates	6 per cent plus 100 mesh 65 per cent minus 200 mesh
Jig tails	93 per cent plus 6 mesh Tyler standard sieve

The average monthly tonnage from all workings mined and milled during the first quarter of 1924 was 59,000. Some of the more significant cost items during this period were as follows:

	Cents per Ton
Pumping	4
Mining—No. 2	64
(Includes cost of delivering to gyratory)	
Mining development—No. 2	15
Total mining cost—No. 2	79
Milling	
Crushing and jigging	32
Flotation, per ton of ore milled	8
Labor, per ton of ore floated	25
Drying concentrates	4
General administrative expense	11
Miscellaneous	2½

The machine shop and blacksmith shop adjoin the mill. They are equipped with the following machines, all of which are belt-driven from a line shaft:

Machine Shop

22 in. x 10 ft. quick change, American engine lathe.
20 in. x 8 ft. quick change, American engine lathe.
36 in. 10-speed American radial drill.
30-in. Barnes drill press.
Robertson power hack saw, No. 5.
Acme bolt-threading machine.
Bignall and Keeler pipe-threading machine.
No. 12 Wells Bros. pipe bolt and pipe-threading machine.

Blacksmith Shop

No. 5 Beaudry power triphammer.
No. 3A New Doty splitting shears.
No. 6 Beatty combination punch and shears.
Plate bending roll.

Limestone Plant a Source of Profit

At the limestone plant, the flotation tailings that have been pumped over from the mill are discharged as 20 per cent solids (4:1 dilution) into two 50-ft. Dorr thickeners, the overflow of which is wasted. The thickened product, 60 per cent solids (2:3 dilution), is then filtered on Portland filters, the filter cake which contains 12 per cent water, passing to six 5x40-ft. Ruggles-Coles driers, fired with pulverized coal. The dried tailings then go direct to bins for loading; or to a tube mill for further grinding, then to an Emerick separator, and thence to bins, according to the grade of agricultural limestone wanted.

Location, industrial conditions, and the character of the country rock combine to make it possible for the American Zinc Co. to take a substantial profit out of its mine tailings, which are converted into agricultural limestone, or used for ballast, roofing gravel, concrete, and other building purposes. Knoxville and other smaller communities near by and the farming country in this section of eastern Tennessee furnish a ready market for these materials.

Tailings from the rougher and bull jigs, which will pass through a ⅝-in. round hole and are 98 per cent plus 10 mesh, are sold for ballast. Occasionally jig tailings are screened to make roofing gravel, all minus 0.5 in. and 80 per cent plus 0.25 in. The oversize and undersize from this material go back into the ballast, for which there is a steady demand.

The limestone tailings from the flotation plant require only to be dried to be marketable as agricultural limestone running 80 per cent minus 100 mesh. A special grade running 80 per cent minus 200 mesh is also produced with the aid of additional grinding and an Emerick separator. This special lime has certain advantages, it is claimed, for peanut growing and certain highway work. It is made only during part of the season.

A corner of the tobacco field on the company's farm. The signboard on the right advertises that Mascot agricultural limestone was used. In the distance on the left is the limestone plant

Design of Limestone Plant Flexible

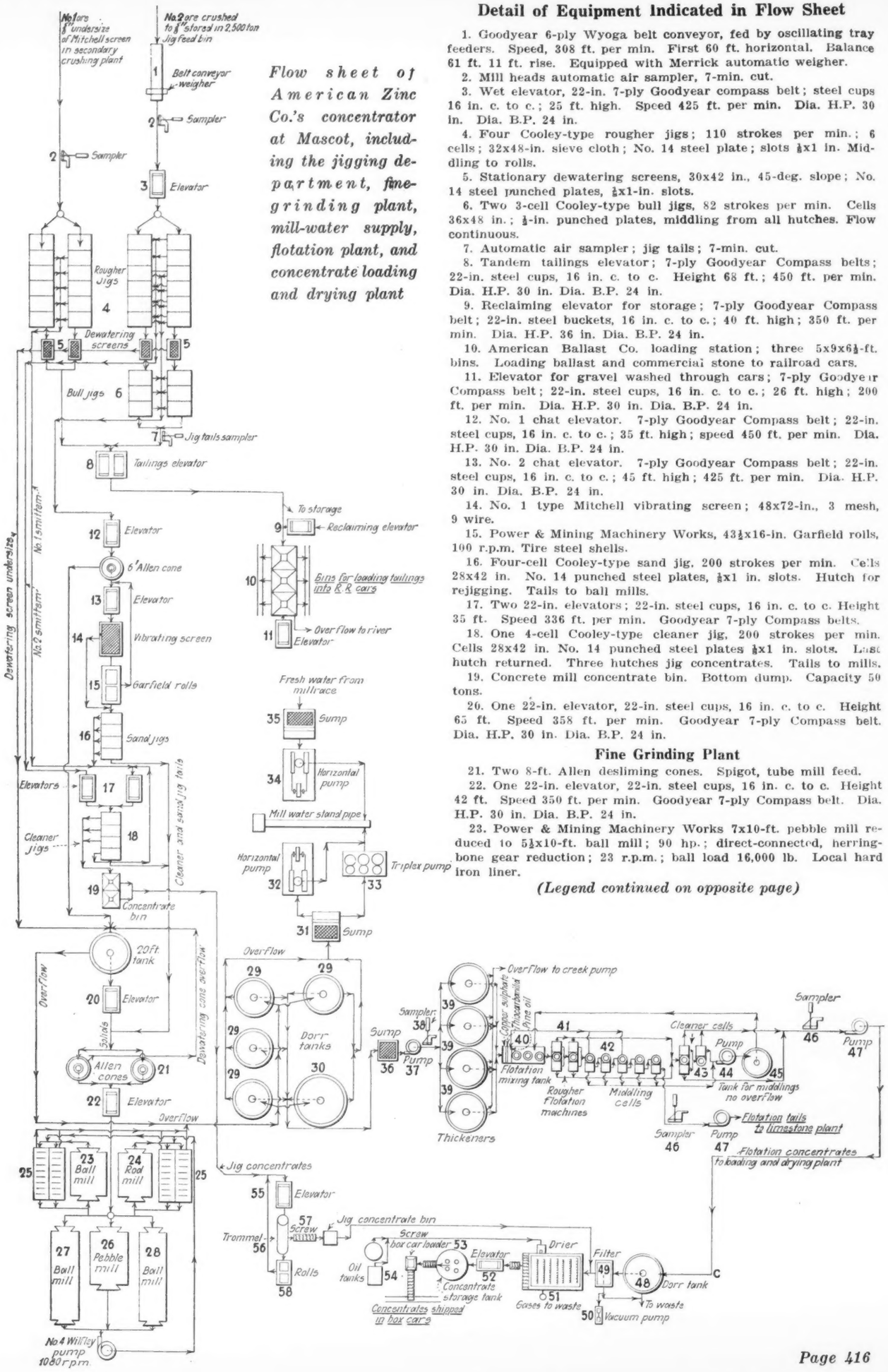
The layout of the plant is roughly indicated in the flowsheet on page 417 which can be compared with the photograph shown on page 409. Flexibility of operation is permitted by the design. All six of the driers can be run for making the "regular" lime, or three of them may be used for this purpose and three for making the special grade. The limestone business is a seasonal one, the dull season being from April to August. During this period the spigot product of the Dorr thickeners, instead of going to the filters, is sent to the pond for storage.

In the filtering plant one of the three Portland filters is used as a spare. The vacuum is provided by a 17x10-in. I-R duplex vacuum pump which maintains 16 to 18 in. of vacuum. This pump and the filters are driven by a 50-hp. motor.

The driers are unlined steel shells. Each unit is equipped with a 30-hp. motor, over-powered on account of dust. Firing on each unit is done with pulverized coal injected with a size A Aëro pulverizer, which breaks the quarter-inch coal, coming from a Swingham-

(Continued on page 417)

Some of the thoroughbred cattle on the company's farm



Flow sheet of American Zinc Co.'s concentrator at Mascot, including the jigging department, fine-grinding plant, mill-water supply, flotation plant, and concentrate loading and drying plant

Detail of Equipment Indicated in Flow Sheet

1. Goodyear 6-ply Wyoga belt conveyor, fed by oscillating tray feeders. Speed, 308 ft. per min. First 60 ft. horizontal. Balance 61 ft. 11 ft. rise. Equipped with Merrick automatic weigher.

2. Mill heads automatic air sampler, 7-min. cut.

3. Wet elevator, 22-in. 7-ply Goodyear compass belt; steel cups 16 in. c. to c.; 25 ft. high. Speed 425 ft. per min. Dia. H.P. 30 in. Dia. B.P. 24 in.

4. Four Cooley-type rougher jigs; 110 strokes per min.; 6 cells; 32x48-in. sieve cloth; No. 14 steel plate; slots ¼x1 in. Middling to rolls.

5. Stationary dewatering screens, 30x42 in., 45-deg. slope; No. 14 steel punched plates, ¼x1-in. slots.

6. Two 3-cell Cooley-type bull jigs, 82 strokes per min. Cells 36x48 in.; ¼-in. punched plates, middling from all hutches. Flow continuous.

7. Automatic air sampler; jig tails; 7-min. cut.

8. Tandem tailings elevator; 7-ply Goodyear Compass belts; 22-in. steel cups, 16 in. c. to c. Height 68 ft.; 450 ft. per min. Dia. H.P. 30 in. Dia. B.P. 24 in.

9. Reclaiming elevator for storage; 7-ply Goodyear Compass belt; 22-in. steel buckets, 16 in. c. to c.; 40 ft. high; 350 ft. per min. Dia. H.P. 36 in. Dia. B.P. 24 in.

10. American Ballast Co. loading station; three 5x9x6½-ft. bins. Loading ballast and commercial stone to railroad cars.

11. Elevator for gravel washed through cars; 7-ply Goodyear Compass belt; 22-in. steel cups, 16 in. c. to c.; 26 ft. high; 200 ft. per min. Dia. H.P. 30 in. Dia. B.P. 24 in.

12. No. 1 chat elevator. 7-ply Goodyear Compass belt; 22-in. steel cups, 16 in. c. to c.; 35 ft. high; speed 450 ft. per min. Dia. H.P. 30 in. Dia. B.P. 24 in.

13. No. 2 chat elevator. 7-ply Goodyear Compass belt; 22-in. steel cups, 16 in. c. to c.; 45 ft. high; 425 ft. per min. Dia. H.P. 30 in. Dia. B.P. 24 in.

14. No. 1 type Mitchell vibrating screen; 48x72-in., 3 mesh, 9 wire.

15. Power & Mining Machinery Works, 43½x16-in. Garfield rolls, 100 r.p.m. Tire steel shells.

16. Four-cell Cooley-type sand jig, 200 strokes per min. Cells 28x42 in. No. 14 punched steel plates, ¼x1 in. slots. Hutch for rejigging. Tails to ball mills.

17. Two 22-in. elevators; 22-in. steel cups, 16 in. c. to c. Height 35 ft. Speed 336 ft. per min. Goodyear 7-ply Compass belts.

18. One 4-cell Cooley-type cleaner jig, 200 strokes per min. Cells 28x42 in. No. 14 punched steel plates ¼x1 in. slots. Last hutch returned. Three hutches jig concentrates. Tails to mills.

19. Concrete mill concentrate bin. Bottom dump. Capacity 50 tons.

20. One 22-in. elevator, 22-in. steel cups, 16 in. c. to c. Height 65 ft. Speed 358 ft. per min. Goodyear 7-ply Compass belt. Dia. H.P. 30 in. Dia. B.P. 24 in.

Fine Grinding Plant

21. Two 8-ft. Allen desliming cones. Spigot, tube mill feed.

22. One 22-in. elevator, 22-in. steel cups, 16 in. c. to c. Height 42 ft. Speed 350 ft. per min. Goodyear 7-ply Compass belt. Dia. H.P. 30 in. Dia. B.P. 24 in.

23. Power & Mining Machinery Works 7x10-ft. pebble mill reduced to 5½x10-ft. ball mill; 90 hp.; direct-connected, herringbone gear reduction; 23 r.p.m.; ball load 16,000 lb. Local hard iron liner.

(Legend continued on opposite page)

24. Power & Mining Machinery Works 7x10 ft. pebble mill converted to 7x10 ft. rod mill. Rod load 40,000 lb., 2- and 3-in. rods; 150 hp. Spur-gear, belt-driven; 16 r.p.m. Local hard iron liner.

25. Two 8x25-ft. model D duplex Dorr classifiers, slope 3½ in., 26 strokes per minute.

26. Power & Mining Machinery Works, 7x12-ft. pebble mill, 90 hp., direct-connected herringbone reduction, 23 r.p.m. Forbes manganese liner. Load 22,000 lb. pebbles.

27 and 28. Allis-Chalmers 5½x22-ft. pebble mill converted to ball mill. Load 40,000 lb. 2-in. balls. Spur-gear, belt-driven, 120 r.p.m. Local hard iron liner. No. 27 mill, 120 hp. No. 28 mill, 138 hp.

Mill Water Supply

29. Four 30-ft. Dorr tanks, 1 rev. every 3 min. Spigot 4 to 1.

30. Dorr tank, 50 ft. One revolution in 2 min. 18 sec.

31. Concrete sump with refuse screen. Overflow to creek pump.

32. Prescott horizontal 13x24-in. duplex, double-acting. Mesabi-type plunger pump; 2,500 gal. per min.

33. Vertical triplex Goulds plunger pump, 14x14-in., 1,000 gal. per min.

34. Prescott 13½x18-in. horizontal duplex double-acting plunger pump. 1,700 gal. per min.

35. Concrete sump for fresh water supply from mill race, overflow to waste.

Flotation Plant

36. Concrete sump and intake with screen.

37. No. 4 Wilfley pump, 1,200 r.p.m.

38. Automatic air flotation feed sampler. 7 min. cut.

39. Four 30x10-ft. Dorr tank thickeners, 1 rev. in 3 min. 45 sec. Spigot 1 to 1.

40. Mixing tank with three Janney agitators, 570 r.p.m.

41. Two double-spitz altered Janney roughers, 570 r.p.m. Overflow to cleaners.

42. Five single-spitz altered Janney middling cells, 570 r.p.m. Overflow to middling pump.

43. One double- and one single-spitz altered Janney cleaner in series, 570 r.p.m.

44. No. 4 Wilfley pump, 960 r.p.m.

45. Circular tank, 20x10 ft., for middlings, no overflow.

46. Automatic air samplers for flotation tails and concentrates, 7 min. cut.

47. Two No. 4 Wilfley pumps, 1200 r.p.m.

Concentrate Loading and Drying Plant

48. Dorr tank, 25x20 ft. One rev. in 2 min.

49. Oliver filter, 5 ft. 4in.x8 ft., belt-driven. Oscillating agitators. No. 3 "O" canvas cover. Cake ¼ in. average thickness, 8 to 9 per cent moisture.

50. Type MO Oliver vacuum pump, 14 in. diameter cylinder, 8 in. stroke.

51. Oil-fired Lowden drier, 12x28 ft.; 2½ strokes per min., 10-in. stroke. Screw conveyors to elevator.

52. Link-Belt elevator, 60 ft., No. 823 K-2 chain. One 8x5-in. cup every fourth link. Speed 270 ft. per min.

53. One 20x20-ft. circular steel concentrate storage tank, capacity 300 tons.

54. Two oil tanks. Total capacity 20,000 gal.

55. Elevator, 18-in. steel cups, 32 in. c. to c., speed 240 ft. per min. Goodyear 7-ply Compass belt. Dia. H.P. 30. Dia. B.P. 24 in.

56. Trommel, 4x8 ft. Slope 2 in. per ft.; ½-in. round hole screen; 17 r.p.m.

57. Screw conveyor, 12 in., 45 r.p.m.

58. Allis-Chalmers 12x24-in. sample rolls, 80 r.p.m. Tire steel shells.

59. Jig concentrates bin, 75-ton capacity. Flat bottom hopper.

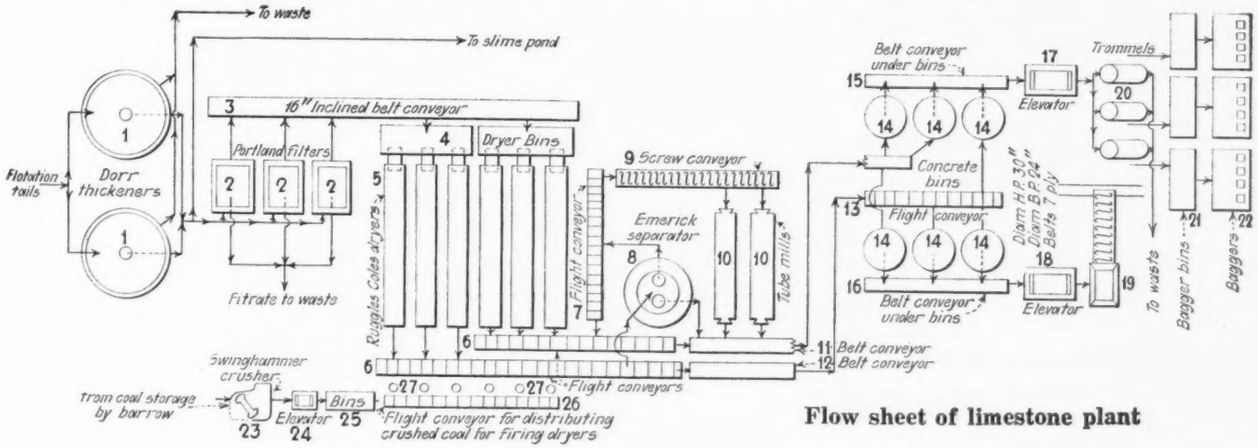
(Continued from page 415)

mer crusher, to about minus 20 mesh and blows it into the furnace. Recently, cylindrical fireboxes of brick, fitting into the discharge end, have been substituted for the square fireboxes that fitted around the discharge end of the driers.

Coal for the pulverizing plant is run in wheelbarrows from the 2,000-ton storage pile to the pulverizer, thence by a 14-in. bucket elevator to a flight conveyor, which distributes it in a series of bins above the discharge end of the six driers. Six feed hoppers deliver the coal to the Aëro pulverizers, one to each pulverizer.

The flight conveyors shown in the flow sheet permit the hot product of the driers to cool somewhat before passing on to the Hy-temp belt conveyors.

Loading is done either in bulk directly into box cars



Flow sheet of limestone plant

1. Two 50-ft. Dorr thickeners, clear overflow, 1 r.p.m.

2. Three 14x14-ft. Portland continuous vacuum filters; 1 rev. per 7 min. Vacuum 16 to 18 in.

3. Inclined 16-in. conveyor; 5-ply Goodyear Wyoga belt. First 65 ft. horizontal, next 128 ft. rises 29 ft., remaining 226 ft. horizontal. Speed 250 ft. per min.

4. Two drier bins 42x15x14-ft. deep; 30-tons-capacity; each equipped with flight feeders. Ratchet and pawl drive.

5. Six Ruggles-Coles driers using pulverized coal, 5x40 ft.; 7 r.p.m.

6. Flight conveyors, 24-in. Speed 80 ft. per min.

7. Flight conveyor, 24-in.; 40 ft. long, 18 ft. rise. Speed 80 ft. per min.

8. Emerick separator, 14 ft.

9. Screw conveyor, 12 in., 18 ft. long, 100 r.p.m.

10. Two Allis-Chalmers 5x22-ft. tube mills with chilled liners, 21 r.p.m. Ball load 40,000 lb.

11. Sixteen-inch conveyor. Goodyear 5-ply Hytemp belt, 550 ft. long, 60 ft. rise, 228 ft. per min.

12. Conveyor, 18-in. Goodyear 5-ply Hytemp belt. 55 ft. rise, 485 ft. long and 320 ft. per min.

13. Distributing 24-in. flight conveyor, 50 ft. long, 80 ft. per min.

14. Six circular reinforced concrete bins, 20 ft. diameter, 54 ft. high, capacity 700 tons each.

15 and 16. Sixteen-inch horizontal conveyor under bins, 65 ft. long. Speed 240 ft. per min.

17. Elevator, 16 in.; 14-in. steel cups, 16 in. c. to c., 36 ft. high. Speed 322 ft. per min. Goodyear Compass belt.

18. Elevator, 16 in.; 16-in. steel cups, 16 in. c. to c. 26 ft. high. Speed 322 ft. per min. Goodyear Compass belt.

19. Screw box-car loader. Capacity 30 tons per hour.

20. Three 4x8-ft. trommel screens, 4 mesh, square holes, slope 1½ in. per ft.

21. Three 20-ton bagger bins, 10x14x9 ft.

22. Three 4-tube Bates valve baggers.

23. Jeffrey Swinghammer crusher, 24 in.; crushes to ¾ in.

24. Elevator, 14 in.; 14-in. steel cups, 16 in. c. to c.; 40 ft. high. Speed 200 ft. per min. Goodyear 7-ply Compass belt. Dia. H.P. 30 in. Dia. B.P. 24 in.

25. Storage bin, 30 tons.

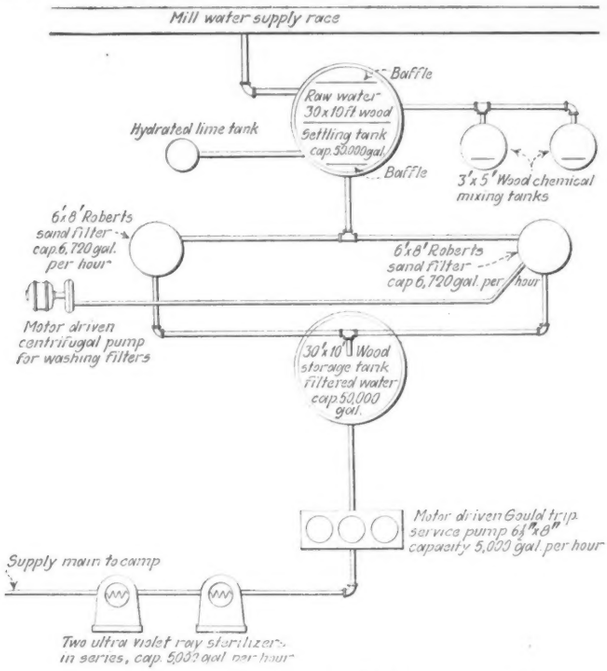
26. Distributing flight conveyor, 16 in.

27. Six Type A Aero pulverizers.

by means of a screw conveyor, or into 100-lb. paper bags or 200-lb. burlap bags by means of a bagging machine. The 100-lb. paper bags are of a special design to prevent dusting while loading and are made by the Bates Valve Bag Co., of Chicago, which also makes the bagging machines.

Company's Farm Advertises Limestone

In an earlier paragraph was mentioned the 1,000-acre farm that forms part of the company's holdings. A novel advertisement for Mascot agricultural limestone! One of the photos on p. 415 shows a corner of a tobacco field with the bins of the limestone plant in the distance, and, near by, a signboard announcing to passengers on the Southern Railway trains that Mascot agricultural limestone was used to make things grow. Besides tobacco are raised oats, barley, corn, alfalfa,


Mill water supply race
Baffle
Raw water 30x10 ft wood settling tank cap. 50,000 gal.
Baffle
Hydrated lime tank
3'x5' Wood chemical mixing tanks
6'x8' Roberts sand filter cap. 6,720 gal. per hour
6'x8' Roberts sand filter cap. 6,720 gal. per hour
Motor driven centrifugal pump for washing filters
30'x10' Wood storage tank filtered water cap. 50,000 gal.
Motor driven Gould trip. service pump 6½"x8" capacity 5,000 gal. per hour
Supply main to camp
Two ultra violet ray sterilizers in series, cap. 5,000 gal. per hour

Flow sheet of plant for sterilizing community water supply

clover, and potatoes. A competent farmer with several assistants is in charge. The cattle include a dairy herd of twenty and a beef herd of 150 to 200 head. Special pride is taken in the separate herd of thoroughbred Aberdeen-Angus cows, now numbering seventeen. Just as the management has standardized on Dreadnaught 60's for general stoping, so it prefers Aberdeen-Angus cattle and Hampshire hogs on its farm. Standardization and simplified practice both! All this is good business. The super-technical reader must not resent the intrusion of these cattle into the sacred field of mining. Let him rather note how the community benefits from the scheme, how the company has diversified its industry so that the farm will work for it even should the mine shut down, and how, in fine, the mere existence of such a scheme betokens a proper attitude of the company toward its enterprise and its employees.

American Labor Only

Both white and colored labor is on the payroll at Mascot, but all of it is American. There are no foreign workmen. The company has 326 cottages, and rents them to employees. The colored camp is segregated. The white labor is practically all native to the surrounding districts. In all there are about 500 men. The approximate distribution of this force is given in the following table:

	Per Cent		Per Cent
Mine	50	Limestone plant	13
Mill	13	Farm	1
Mechanical	12	Electrical	1
Construction	7	Miscellaneous	3

Of the mine labor about 30 per cent is colored. Machine men and all other skilled workmen are white. Shoveling and other similar work is done by colored labor.

Labor is procured through a central employment office serving all departments. A labor commissioner is in charge. Each foreman hires and discharges his own men. At times a scarcity of labor prevails and greatly hampers operations. In an effort to remedy this condition, the company recently, when it needed shovelers, offered a bonus of $5 to each employee who brought in a new colored shoveler who worked two weeks of five shifts each. At the end of each additional five-shift week that the new man remained, the one who brought him was to receive $2, making thus a total maximum bonus of $21 for the ten-weeks period during which the "war measure" was good.

During the last four years the labor turnover, due to the colored workers principally, has fluctuated widely as industrial conditions have varied. In dull times even the negro will show a greater fondness for his job. The accompanying table gives illustrative figures:

Year	Total Plant Turnover, Per Cent	Colored Turnover, Per Cent	White Turnover, Per Cent
1919	400	686	114
1920	370	698	288
1921	169	192	161
1922	140	258	122
1923	249	476	211

Examination by the company physician of every applicant before he is given employment is required, and no one is assigned to work for which he seems not physically adapted. A workman who has been absent six months must be re-examined. This helps keep down the accident ratio, which in 1923 was only 0.68 accident per 1,000 man-hours worked in the mine. "Safety first" is preached in Mascot as elsewhere, and the teaching is bearing fruit.

Employees and their families receive medical attendance when necessary for a nominal sum per month. A hospital where all ordinary cases can be handled is provided. A water supply sterilized by the ultra-violet ray is provided for the community. The layout and equipment of the sterilizing plant is shown on this page.

Mascot has its baseball team, its band, and its social affairs that make life there normal and attractive. It has its churches, two of them, and a community house for meetings. It is not a "camp," but a normal community, though company-owned and controlled, that in course of time will be but a suburb of Knoxville as the latter grows. Creating this normal atmosphere is an achievement of the management.

The American Zinc Co. of Tennessee is a subsidiary of the American Zinc, Lead & Smelting Co. The names and positions of the local staff at Mascot are as follows:

H. I. Young, general manager.
C. B. Strachan, general superintendent.
M. H. Newman, geologist.
H. A. Coy, superintendent mining department.
R. Ammon, superintendent milling department.
R. P. Immel, superintendent American Limestone Co.
N. L. Allen, superintendent power, mechanical and construction.
P. M. Arthur, superintendent employment and welfare department.
H. F. Caldwell, auditor.
H. R. McElveen, superintendent farm.

The World's Biggest Borax Deposits

Situated in the Desert Areas of California and Nevada

By William F. Foshag
United States National Museum

William F. Foshag

COMMERCIAL DEPOSITS of borax are of limited distribution. The deposits of California and Nevada are by far the most important in the world. Localities other than those in the United States producing borax are the saltaras of Chile and Argentina, the suffoni of Italy, the sedimentary beds of Panderma, in Asia Minor, and the salt deposits of Stassfurt.

The deposits in the West owe their importance to rich beds of calcium borate, the mineral colemanite, which is found in no other borax district. Recent years have seen an increase in the number of commercially important deposits found, and no doubt others remain to be discovered. The importance of these deposits can be judged by the fact that during 1920, 120,320 tons of ore, valued at $2,173,000, was produced. Borax finds its principal uses in the manufacturing of glass, enamel, household and toilet preparations, preservatives, fluxes, and chemicals.

Found in California and Nevada

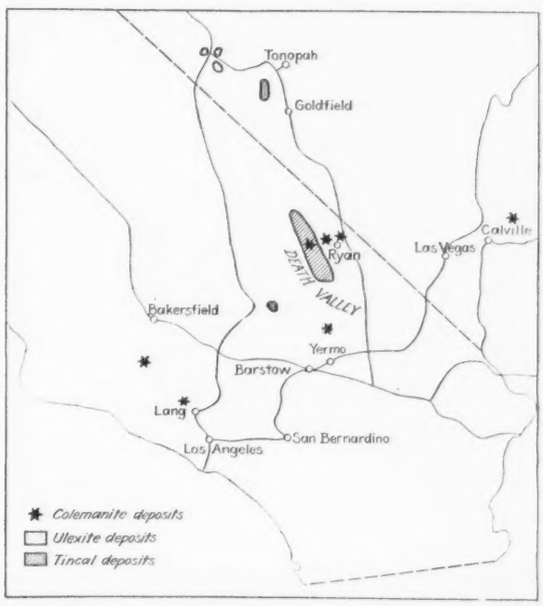
The borax-bearing deposits of the West are confined to the southern part of California and Nevada. This area embraces the counties of Los Angeles, Ventura, Kern, Inyo and San Bernardino, in California, and Clark, Esmeralda, and Mineral, in Nevada. These deposits can be divided into three classes: (1) Lakes and playas carrying borax; (2) playas carrying ulexite, the double sodium-calcium borate, and (3) sedimentary beds carrying colemanite, a hydrous calcium borate.

Before the discovery of the colemanite beds the lakes and playas were the important sources of borax. The first American source was Borax Lake, in Lake County, Calif., where crystals of remarkable purity were recovered from the muds of the lake. The nearby Lake Hachinhama also produced considerable amounts. At the time these deposits were becoming practically exhausted, the borax-bearing playas of the Mohave desert region were discovered. In these deposits the boron-bearing mineral is borax, the natural sodium tetraborate, intimately mixed with sodium sulphates, carbonates, and chloride. The salts formed a crust on the surface of the playa that was scraped up and refined, and, re-forming from time to time, gave a more or less continuous supply of borax. The presence of sodium carbonate in these salts prevented the formation of the mineral ulexite, characteristic of the second type of deposit. Deposits of the type carrying borax are Searles Lake, Death Valley, and some minor playas in California and Fish Lake Valley, in Nevada.

In the second type of deposit the double calcium-sodium borate, ulexite, is the ore mineral. This mineral occurs in nodules either isolated or aggregated in masses of more or less purity in the stiff muds of the playas. The ulexite nodules, made up of a matted mass of needles, resemble cotton, and have received the popular name of "cotton balls." Associated with the ulexite is sodium borate, chloride, and sulphate, though sodium carbonate is absent. The cotton balls are recovered by shallow excavation, the nodules being picked out of the muds by hand. These deposits, being rather purer than those of the borax type, were much sought after and exploited. The playas carrying ulexite have been thoroughly worked over and will probably produce but little additional borax. Ulexite-bearing playas are Rhodes, Teels, and Columbus marshes, in Nevada, and Kane Lake, in California.

Production of borax ores is now confined entirely to those deposits carrying the calcium borate, colemanite. Their greater richness and purity have caused the abandonment of the lakes and playas as sources of borax. The colemanite occurs as irregular masses in soft shales associated with fine-grained sandstone, thin beds of cherty limestone, and volcanic flows. This association, together with an abundance of rain-prints, ripple-marks, and sun-cracks, indicates shallow-water deposition, and the beds are probably accumulations similar to those now forming in the present-day playa lakes.

Colemanite is found in a number of different habits. Coarse cleavable ores are the most common type, often with numerous vugs lined with clear, monoclinic crystals. Other types that are common are nodular ores with radiated structure or hollow and lined with crystals, and massive radiated ores. The mineral is white when pure, but is often colored gray or brown by included mud. The ore seldom forms a bed of uniform thickness, but rather is aggregated into large



Deposits of California and Nevada are indicated

Colemanite-bearing bed at Borate, Calif., showing bands of howlite

pockets, sometimes swelling to rich bodies, and at other times pinching to thin beds of scattered masses.

Five general localities have produced colemanite: Lockwood valley, in Ventura County; Lang, in Los Angeles County; Borate, in San Bernardino County, and the Death Valley region, in Inyo County, all in California, and in the Muddy Mountains, in Clark County, Nev. It has also been reported from other localities in this region, but these reports need confirmation.

Ventura County—The deposits in Ventura County lie in the extreme northeast corner near the Kern County line. The nearest point is Bakersfield, 55 miles away, but the ore has been hauled to Lancaster, a station of the Southern Pacific R.R. Three mines, the Frazier, Columbus, and Stauffer, have opened up these deposits. Colemanite occurs in a series of shales and volcanic flows that have been extensively folded and faulted. Thin beds of limestone are met with, and lenses of cherty limestone are abundant in the shales. The colemanite is found associated with one of these limestone layers, in which it occurs as bunches and irregular masses of ore or intimately intergrown with calcite. The mineral aggregate is either coarsely crystalline or shows radial structures. Columnar masses, locally called needle ore, are common.

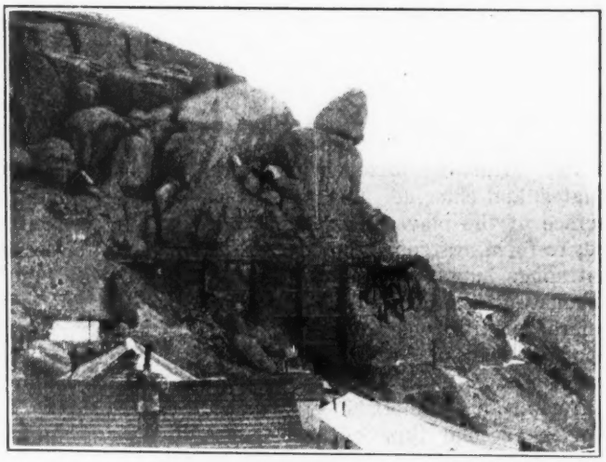
Los Angeles County—The deposits in Los Angeles County are located in Tick Canyon, about 6 miles from Lang on the Southern Pacific R.R. The area is one of sedimentary rocks, chiefly sandstones and conglomerates, with minor shales and volcanic flows. The colemanite is associated with a series of thinly bedded shales intercalated between two thick flows of andesitic lavas. Wherever observed the borax bed is made up of layers of colemanite interlaminated with shale. The ore is coarsely granular or occasionally columnar. Scattered through the colemanite are "augen" of the calcium borosilicate, howlite, and in the lower workings considerable ulexite is encountered.

San Bernardino County—The first deposits of colemanite to be worked are those of Borate, in San Bernardino County. The deposits are about 4 miles east of the old silver camp of Calico and 8 miles by wagon road from Yermo, a station on the Salt Lake Branch of the Union Pacific R.R. The colemanite beds are found in a thick series of shales and sandstones, somewhat folded and faulted and unconformably overlain by an andesitic breccia, the "calico" rock of the silver miners. The ore consists of nodular masses of colemanite aggregated into beds of variable thicknesses. These beds have been opened by an inclined shaft and numerous minor workings. The deposits are now idle except for a small amount of work done by lessees, though systematic exploration might reveal further good orebodies.

Inyo County—The deposits of Inyo County are the ones now being most actively worked. About the Camp of Ryan are grouped the producing mines—the Biddy McCarthy, Lila C., Lizzie V. Oakley, and the Played Out. The boron-bearing series outcrops along the slope of Furnace Creek wash. It consists mainly of soft shales and fine-grained limestones unconformably overlain by a thick flow of basalt, the ore being near the top of the series. The ore is largely colemanite, but some ulexite and several of the rare calcium borates are also encountered. In Furnace Creek wash below Ryan, a rich bed of colemanite has been developed at Russell Camp. Here the ore is of great purity, consisting entirely of coarse cleavable colemanite.

Mount Blanco Potential Source

The deposits at Mount Blanco are about 17 miles below Ryan in a series of clay hills to the south of Furnace Creek wash. This series, more than 4,000 ft. thick, is made up of soft shales and fine, even-grained sandstones, with a few thin flows of basalt. The boron-bearing bed outcrops prominently as the backbone of the ridge, and is conspicuous because of the thick covering of efflorescent salts. This efflorescence is largely sodium sulphate carrying about 20 per cent borax. In this deposit ulexite is rather prominent, and in some parts of the bed it makes up the entire ore. Colemanite occurs as a much honeycombed mass of crystals colored buff by included mud. In some parts of the orebody the rare calcium borates, inyoite and meyerhofferite, are in sufficient abundance to constitute



A corner of Ryan and a view across Furnace Creek

ore. These deposits are not being worked now, but can produce large amounts of high-grade borax ore when the more accessible beds have become exhausted.

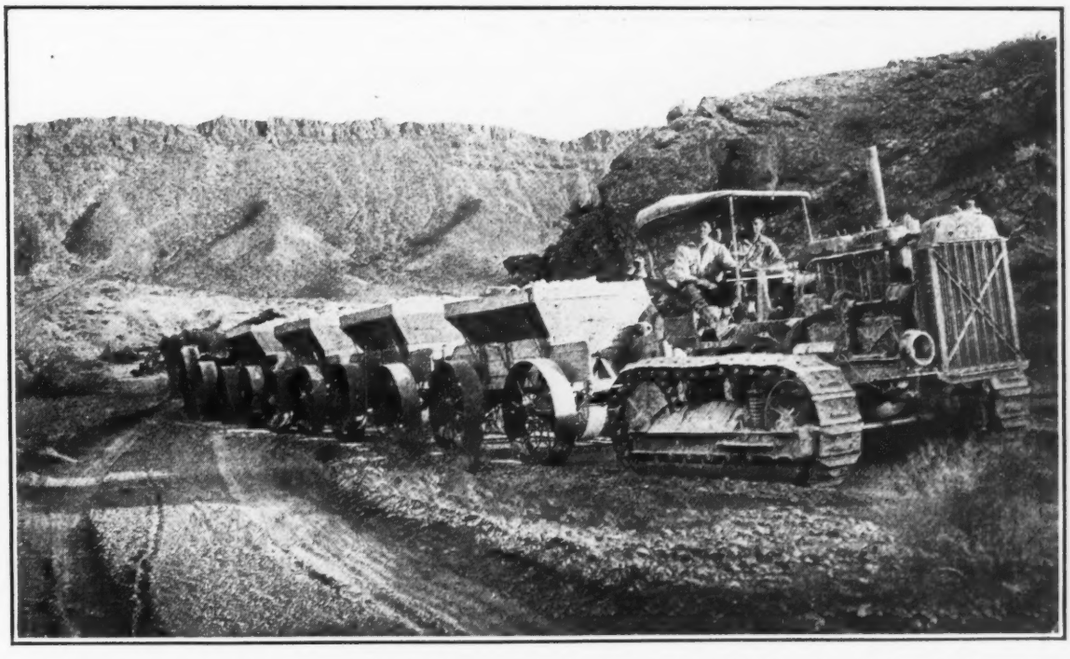
Clark County—Two deposits of colemanite have been found in the Muddy Mountains, east of Las Vegas. The largest of these is that near Calville, at the Colorado River. The boron-bearing series consists of a thick bed of tuffaceous limestone with minor amounts of calcareous shales and volcanic ash. Colemanite is found in irregular bunches in the calcareous shale. Much high-grade ore has been blocked out and a large production is soon to be expected. The second deposit occurs in the White Basin about 15 miles southwest of St. Thomas. The occurrence is similar to that at Calville except that the shales are somewhat more prominent here. The deposit is now being actively exploited and the ore is hauled to Moapa, a station on the Salt Lake Branch of the Union Pacific Railroad.

The three types of deposits have somewhat different origins, although the ultimate source of the boron is probably the same. The borates are confined to an area of past intense volcanic activity and the boron is no doubt in large part a result of this activity. The greater part of the borax, if not all of it found in the playa lakes, has come from the sedimentary beds of Tertiary age which carry the colemanite. Where this borax has entered basins free of sodium carbonate the mineral ulexite has formed. The action of borax solutions on gypsum brings about readily the formation of this mineral. Where the basin carries considerable carbonate, borax is the mineral formed. The colemanite is the result of the action of percolating waters on pre-existing beds of ulexite. Borax is leached out and the insoluble calcium borate left behind is colemanite according to the following relationship:

$$\underset{\text{Ulexite}}{2NaCaB_5O_9.8H_2O} = \underset{\text{Borax}}{Na_2B_4O_7.10H_2O} + \underset{\text{Colemanite}}{Ca_2B_6O_{11}.5H_2O} + H_2O$$

The borax that leaches out finds its way into playa basins to form the borax and ulexite beds of the present-day playa lakes. The accompanying illustrations show typical specimens of the ores.

The accumulation of boron minerals of this type depends upon a combination of favorable circumstances that are rarely duplicated. Borax therefore is and probably always will be a rare commodity. There is first required a source of the boron—that is, volcanic activity. Suitable basins must be present for the accumulation of the salts, and, finally, the climate must be sufficiently arid to prevent the removal of these relatively soluble compounds. These conditions seem to have existed throughout a great part of the Basin and Range Province. Favorable localities for the prospecting of borax are scattered throughout this entire region. Intelligent search for borax will probably add new deposits in this area.



The 1924 version of 20-mule team borax. Hauling from the Muddy Mountains in Nevada

Discussion

To Help Lay the Ghost of the "Molten Magma"

THE EDITOR:

Sir—Molten rock and molten magma (as commonly used) are terminological inexactitudes. Their use often reflects ignorance of fundamentals. Spurr ("The Ore Magmas") and Lewis (current number of the *Engineering and Mining Journal-Press*) have called attention to these erroneous designations.

The unerupted magma does not result from simple fusion and is therefore incorrectly termed a *molten magma.* Great authorities have erred in using it (see "Geochemistry," Frank Wigglesworth Clarke, Bull. 695, U. S. Geological Survey, fourth edition, page 285, 1920). In this remarkable compendium the term is used as a chapter heading, though the text indicates clearly that the author is under no error of conception. (*Op. cit.*, p. 292 *et seq.*)

The unerupted magma is a solution of minerals, metals, and other substances of which all or any part may be in a solid or gaseous or viscous state. This magma generally possesses characteristics that are entirely different from those of ordinary molten matter (which has resulted from fusion), as its various components are usually dissolved in each other. In solidifying, crystallization (partial or complete) depends upon many factors which require, for their elucidation, a full knowledge of the laws underlying the principle of eutectics and in particular the application of the famous *phase rule* as developed by J. Willard Gibbs (1839-1903). Eutectics and the phase rule are, of course, elements only of the general theory of energetics, thermodynamics, and the chemical and electrical potentials of solutions. These problems have never been fully worked out. They are very complex and lead to exceedingly cumbersome mathematical expressions. A three-axis (space) co-ordinate system is required for their graphical representation.

The developments of recent years in the analysis and dissection (metaphorically speaking) of the atom and the recognition of the fundamental identity of matter and energy have made a general solution of the problem still more difficult. With these difficulties in mind, the following terms are suggested and may prove useful and suffice for a long time pending more exact scientific determinations:

1. The magma (the viscous or liquid or gaseous unerupted magma, generally forming a complex solution).

2. The magmatic intrusive (the unerupted magma, cooled in place, under cover, which may or may not have lost some constituents of the magma).

3. The lava (the erupted magma, which will have lost many of the constituents of the magma).

The term *molten magma* should be entirely eliminated. It is, to say the least, pleonastic, tautological, and redundant, and fundamentally incorrect.

Salt Lake City, Utah. H. A. STRAUSS.

Assaying for Tin in Drosses

THE EDITOR:

Sir—I have been very interested in reading your article "Determination of Lead, Copper, and Tin in Drosses," by J. H. Hastings. Under the heading "Tin and Copper in Tin Drosses," the use of iron nails for the reduction to stannous chloride has been described. Iron was used for this reduction in the original Pearce assay. The nickel coil has decided advantages over this method and its use is described by S. S. Beringer as follows in discussing the Beringer tin assay[1]:

Make up to 150 c.c. instead of 200 c.c., and transfer the contents of the beaker to a 250-c.c. flask. Add 15 to 20 grams of common salt, insert a nickel coil, and boil on a hot plate for thirty minutes. The salt in the liquor greatly improves the boiling; it also raises the temperature and stimulates the action of the nickel. After thirty minutes the nickel is raised to the neck of the flask, washed with boiling water by means of a wash bottle, and removed. Care should be taken to keep the liquor boiling all the time. Then put on a lead collar, insert an eduction tube, and connect with a Kipp's carbonic acid apparatus. I prefer to use a Kipp's apparatus to placing calcite in the liquor to fill the flask with CO_2. Then cool to room temperature.

Denver, Colo. ELDRED A. KNAPP.

"Tube-mill Grinding Media"

THE EDITOR:

Sir—In your July 26 issue, under "Tube-mill Grinding Media," you speak about the possible use of steel cubes versus steel balls and of the use of cubes.

In this connection, I believe there are numerous records to show that different shapes of grinding bodies have been used in order to improve the grinding results. In spite of this test work, most of the grinding now done is with the ordinary spherical balls and in some cases, rods. We have done quite a little experimenting of our own on various types of grinding media; in fact, we have developed a double cone-shaped media where a large lineal contact surface is exposed.

It must not be forgotten, however, that in the case of different types of media, where too much surface is exposed for the correct weight involved, energy is going to be wasted as this weight is distributed over a number of particles, and if the exposed surface is too great, the amount of crushing produced will be nil. This is particularly true where relatively coarse ore is being ground.

There is no doubt that odd-shaped grinding bodies will produce excellent results under certain conditions, but it is certainly not a sure cure for all grinding evils and experiments should be watched closely to check these points and the user must not assume that a satisfactory solution in one case will solve all problems.

New York, N. Y. HARLOWE HARDINGE.

[1] "Textbook of Assaying," C. and S. S. Beringer, Charles Griffin & Co., London.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

CONTINUED advance in sterling exchange and the consequent fall of the gold "premium" threaten the profits of an increasingly large group of gold producers on the Rand, in South Africa.

Copper concentrates from the new Granby concentrator are now being shipped to the Tacoma smelter. They could not be handled economically at Anyox.

A receiver has been asked by the creditors of the Idaho Gold & Ruby Co., which has been engaged in an attempt to exploit gold placers in Idaho.

The McIntyre Porcupine Mines Co. will hereafter pay 20 per cent annually on the par value of the stock.

Hamilton, in White Pine County, Nev., is the scene of active development on and near old silver bonanzas.

A recommendation by Bureau of Mines engineers for the erection of a government owned reduction plant at Anchorage, Alaska, seems to establish a new precedent.

A surplus of mine labor is reported from the Porcupine gold district in northern Ontario.

Copper produced by the Engels Copper Co. cost 11.65c. per lb. after crediting gold and silver and before deducting depreciation.

A large concentrator is being erected at Rifle, Colo., by the United States Vanadium Co. to handle ore produced in the vicinity.

Thus far only importers who are selling accumulated stocks have benefited by the tungsten tariff of 45c. per unit.

McIntyre Porcupine Will Pay 20 Per Cent Annually

Best Year Just Finished—Bullion Income $3,291,878—New Shaft 2,500 Ft. East of No. 5

The annual report of the McIntyre Porcupine Mines Co. of Porcupine, Ontario, just issued, records a new high figure in production and earnings for the company. It was also announced that, commencing with the September dividend payment of 5 per cent, the dividend basis would be 5 per cent quarterly instead of the 15 per cent annually which has been paid for the last few years.

During the fiscal year 360,140 tons of ore were treated, of an average value of $9.69 and the bullion recovered was $3,291,878 as compared with $2,250,000 for the preceding year. Operating costs were $1,615,453 and general expenses $172,878, leaving net operating earnings of $1,502,846, as compared with $915,224 in 1923. After allowance for the non-operating revenue, less appropriation for taxes, net profits before depreciation were $1,488,486, an increase of $570,000.

Current assets now stand at $2,012,281 and current liabilities $189,235; the surplus is $3,137,488. The results of development work during the past year are very favorable, particularly on the lower levels. The No. 5 shaft has now reached a depth of 2,500 ft. and is practically at the limit of its capacity. As the general trend of McIntyre orebodies is toward the east a new shaft will be sunk 2,500 ft. east of the No. 5 shaft and having an objective of 4,000 ft. depth. The company has acquired additional ground and now owns a 75 per cent interest in the Platt-Veteran property and 98 per cent of the Plenaurum. Ore reserves are estimated at $11,313,816, the average grade being $9.79; of this 182,184 tons is broken ore in the stopes.

Trail Ore Receipts Pass 300,000 Tons for 1924

THE ore receipts at the Trail smelter for 1924 passed the 300,000-ton mark during the third week in August, the principal contributors to the total being the Consolidated M. & S. Co.'s own mines, 275,607 tons; Silversmith, 5,668 tons; Quilp, 5,125 tons; Lone Pine-Surprise-Last Chance, 3,950 tons; and Knob Hill, 3,115 tons. The last three mines are situated at Republic, Wash. The shipments for the third week in August were: Consolidated company's mines, 8,562 tons; Cork-Province, 45; Knob Hill, 56; Quilp, 53; Silversmith, 151, and Van Roi, 50 tons.

Quincy's New Generator Making Good

The management of the Quincy mine, in the Michigan copper district, reports good results in the use at the mine of power transmitted from the new turbo-generator run by exhaust steam from the stamp mill. There is adequate power for operation of electric locomotives underground and machinery in the shops. It represents the biggest single item in Quincy's economy program in recent months.

New Claimant for Idaho Tunnel Driving Record

Star Crosscut Advanced 421.4 Ft. in One Month—Three Drilling Shifts —Mechanical Mucking

What is believed to be the record for Idaho in tunnel driving was made by employees of the Hecla Mining company recently in extending the Star crosscut 421.4 ft. in one month. This enterprise is one in which the Hecla Mining Co. and the Bunker Hill & Sullivan Mining & Concentrating Co. are jointly interested, operating under the corporate name of Sullivan Mining Co. The actual work is being done by the Hecla company, the crosscut being projected from the 2,000 level of the Hecla mine almost two miles to the Star vein. The crosscut is being run through Revett quartzite, a hard siliceous rock.

The tunnel is 8 by 8 ft. in the clear. The work is being done by day's pay and without bonus, the men receive $1 per day more than the regular scale. The footage includes laying the track on permanent grade, maintaining the ditch for drainage and bringing up ventilating pipe as required. In short, as the work advances the crosscut is complete and ready for service. Three eight-hour shifts are employed, and each shift has three miners, one mucking machine operator, one helper and one motorman. Leyner machines are used, two on a horizontal bar at one time. The average round on each shift is 20 holes. These facts are given by Charles H. Foreman, chief engineer for the Hecla company, who states that the record month was last May, when the big crosscut was advanced 421.4 ft.

Coniagas Acquires 61¼ Per Cent of Conarium Mines, Ltd.

Interim Report Shows Status Since Cobalt Fire—Liquid Assets Total $2,416,371

In view of changed conditions, the Coniagas Mines of Cobalt, Ont., has issued an interim report. Since the annual report was issued the mine shafthouse and surface equipment at the Cobalt mine was destroyed by fire, which resulted in complete cessation of all operations in Cobalt. During the first four months of the company's fiscal year estimated profits amounted to $100,000, and it is anticipated that the money to be recovered from the insurance companies will amount to $157,500.

It is said that the company spent $88,000 on the Ruby group of claims, but as the results were not encouraging the option was allowed to lapse. Up to July 31 operations at the Beaver property had cost the company approximately $113,500. A considerable amount of ore was treated from the upper levels of the property, but the development of the lower diabase-Keewatin contact has been disappointing.

Work is now confined to completing a crosscut at the 1,200 level to the west boundary of the Prince-Davis property, which work was required under the option agreement. Though the report does not say so, it is understood that when this work is finished Coniagas will abandon any further operation of the Beaver.

The report gives considerable detail regarding the consolidation of the Armstrong-Booth, Goldale, and Newray properties, in the Porcupine district. A new company known as the Conarium Mines, Ltd., with a capital of $5,000,000 has been formed to take over the various interests. Under the agreement the Goldale Mines received 228,000 shares of $5 par in the new company; the Newray Mines 172,000 shares, and the Armstrong-Booth 60,000 shares. The remaining 540,000 shares will be taken up by the Coniagas Mines at a price of $1,050,000, of which $250,000 was paid on allotment, and the balance is payable within two years from June 12. Under the agreement the Coniagas acquires 61¼ per cent in the new company.

For the first time a combined statement of Coniagas Mines and the Coniagas Reduction companies has been issued, which shows cash in banks, bonds, and guaranteed loans to the amount of $1,870,397 and accounts receivable, $545,777, making a total of $2,416,371; against this there are accounts payable of only $1,127. This shows net assets of $3 per share on the Coniagas stock.

Rich Strike in United Mine

The United mine, near Ainsworth, B. C., for the last twenty years a producer of lead-silver ore, has opened a streak of ore 18 in. wide which carries $140 in gold. The gold values occur in the zinc in a vein 6 ft. wide which also contains a 2-ft. streak of galena ore.

The background in this picture a stretch of the high Sierras in California. The "prospector" lives in Hollywood

Charlie Chaplin Will Portray Vicissitudes of Hardluck Prospector

Pictures Taken in California Sierras Simulate Klondike—Nome Reproduced in Hollywood—To Visit Alaska

To convert the pathos and suffering of the doughboy into laughter was a task successfully accomplished by Charlie Chaplin in the film "Shoulder Arms." The hapless prospector now comes into his own, to share the laughs and sympathy of the devotees of the silver screen. Chaplin's next production will mark the most ambitious attempt he has yet made in the field of comedy. In the rôle of hardluck sourdough at the time of the stirring days of the Klondike and the gold rush to Alaska he will portray the hardships of the pioneers who scrambled in mad haste to discover gold in that icebound country. Like the majority, Chaplin finds none; but from the fact that the caste includes a heroine, there may be compensations.

The technique of the portrayal will be elaborated with all the attention to detail of which the best productions of the comedian are characteristic. Preliminary work took place in the California Sierras during the winter months, when a force of over 1,000 "supers," most of whom were drawn from the ranks of the hobo and the bum, whose attire needed no change or supplement in so far as realism was concerned, were used in mob scenes depicting the Alaskan rush and its attendant hardships. Many photographs were taken from the summit of Mount Lincoln. Chilcoot Pass, the famous gateway to the Klondike, was duplicated; and a trail was cut through the snow of the high Sierras to bring realization and to insure the desired effect.

In the Chaplin studio grounds at Hollywood a mining camp has been built that is an excellent reproduction of the main section of Nome in the days of '98. A background of artificial

Strange equipment for a prospector seeking the elusive dust

snow-capped peaks emerges above and covers the studio buildings. Here all the close-up shots and interior photographs will be taken. Later in the year Chaplin and his company will go to Alaska, where the concluding shots will be made, in a locality where almost illimitable expanses of snow are available.

The "poor" prospector is not without one friend

An intensive study of effect for almost every foot of the film, which is expected to reach a length of eight or more reels, is expected to result in a production of a unique character. The work will be completed late this year, and release may be anticipated early in 1925.

Engels Copper Cost 11.65c. Per Pound Before Depreciation

The half-yearly statement of the Engels Copper Mining Co., operating copper mines at Engelmine, Calif., records a production of 6,667,590 lb. of copper for the six months period ended June 30, 1924. Operating costs were $541,455 and freight and smelter charges $310,495, a total of $851,951. The per-pound cost totals 12.77c. Gold and silver to the value of $75,358 was produced during the period, or at the rate of 1.13c. per lb. of copper. Applying this as a credit leaves 11.65c. as the cost of copper per pound.

The average price of copper for the period was 12.80c. The operating profit before depreciation was $82,393. Capital expenditures totaled $185,818, distributed as follows: No. 10 tunnel development, $115,582; Superior No. 2 shaft, $8,526; removing upper camp buildings, $3,984; mine development, $39,969; experimental plant for treatment of concentrates, $8,142; sundry equipment, $6,340. Cash on hand is $512,614; ore broken in stopes inventoried at $406,340, and material and supplies at $103,819.

Electricity and Machinery Cut Cost of Banca Tin

BANCA TIN, the Dutch East Indian Government company which controls the mines at Banca, reported a prosperous business during the first five months of 1924, and the controller of sales ascribes the profits to reduced expenses as well as to high market prices. A report to the U. S. Department of Commerce says that the electrification of the entire industry trebled the capacity. The increased use of machinery permitted of considerable economy in labor costs. Costs of production were reduced by about 30 per cent, from about 98 florins to about 63 florins per picul (1 picul = 133⅓ lb.) of tin produced. It is expected that for the current year the costs of production will be further reduced to about 58 florins per picul.

Granby Diverts Concentrates from New Concentrator to Tacoma

Anyox Plant Cannot Smelt Them Efficiently—Mill Is Doing Excellent Work

Finding that it is unable economically to handle the concentrate from its new mill in its blast-furnace plant at Anyox, B. C., the Granby Consolidated Mining, Smelting & Power Co. has begun to ship the output of its mill to the Tacoma smelter, and will continue to follow this practice pending the installation of equipment to handle it at Anyox. Of exactly what this installation will consist remains to be determined by experiment. In the meantime, the force at the Anyox smelter has been reduced.

The new mill is giving complete satisfaction, and, though designed for only 1,000 tons, is treating 1,500 tons per day, and, it is expected, will be tuned up to 2,000 tons per day. The 100-ton experimental mill, which has been idle for some time, is being reconditioned, ready for service again. It is probable that this mill, besides supplementing the larger one, will be used for custom ore, of which there is likely to be a considerable supply from new mines in the northern part of British Columbia in the near future.

New Zinc Finds West of Galena, Kan., Attract Attention

Several local mining companies are investigating the recent finding of zinc ore near Oswego, Kan., about 30 miles west of Galena. Among the companies reported to have taken leases there for exploration purposes are the Tulsa Lead & Zinc Co., the Howe Mining Co., and the Sparks Mining Co., of Galena. The Sparks company agreed to start development work in ten days. In addition, a number of individual prospectors and two-man partnerships are investigating what may prove to be a new field.

Receiver Asked for Idaho Gold & Ruby Co.

Huge Promotion Based on Placer Deposits—Much Money Spent—No Returns

Claims aggregating $854 have precipitated a receivership for the Idaho Gold & Ruby Mining Co., operating a placer deposit on Boulder Creek near Leonia, Idaho. The company has a capitalization of $6,000,000 and has been the cause of the most intense promotion activity in the West. Notwithstanding that the enterprise has been reported adversely by engineers, John M. Schnatterly, a country blacksmith, launched a promotion which started one of the largest construction enterprises of any placer proposition known.

Miles of roads and great canals to bring water to the gravels owned by the company were constructed during a period of fifteen years. Plans called for the mining of 100,000 yd. of gravel per day for 365 days a year, and 600 per cent yield to any one investing in the company was predicted by the management. Men were induced to work twelve hours a day and received stock in the company in payment for their labor. Some gravel was actually sluiced and a clean-up was promised for many months, but some excuse for delay always seemed to be forthcoming.

Mr. Schnatterly experienced many troubles; his life was sought on several occasions. He was killed by an explosion of gasoline on his palatial motor launch last year, when he was burned to a crisp in resulting fire which destroyed the boat. During his career he spent many hundred thousand dollars, and since his death the company has had trouble in carrying on the work, which has culminated in the receivership started by creditors at Bonners Ferry. The enterprise is now confronted by a mountain of debt estimated by the receiver at $1,800,000, with assets of approximately $50,000.

Lessees Will Leach Nevada Consolidated Dumps

Lessees headed by Ira B. Joralemon are making preparations to leach the Keystone dumps of the Nevada Consolidated Copper Co., at Ruth, Nev.

During the early months of the present year Mr. Joralemon spent several thousand dollars experimenting with the dumps at Ruth, and was then convinced that the ores could be treated at a profit.

The system to be used is similar to that employed at Butte, Mont., and at Clifton, Ariz., for many years, and consists of flooding dumps with water which dissolves copper. The metal is later precipitated in the launders by the use of "tin" cans or scrap iron. It is said that a considerable portion of the water secured for the new plant will be pumped from the bottom of the copper pit and also from deep shafts of the company, which is already impregnated with copper. Launders, pipes, and tanks will be made of redwood because of the corrosive character of the liquor.

Argentine Government Galvanized Sheet Order Requires 5,250 Tons of Slab Zinc

TO GALVANIZE the 39,000 tons of sheet iron sold recently to the Argentine Department of Agriculture to use in fighting locusts will, it is estimated, require 5,250 tons of slab zinc. It is said that a coating of 2½ oz. a square foot has been asked for by the Argentine Government.

The U. S. Steel Corporation, which through a subsidiary owns the Donora, Pa., zinc smelter, will not go into the market to buy any considerable part of the zinc required. Instead, it probably will distill the zinc at its Cherryvale, Kan., plant, or at Donora. Donora has a capacity of 9,000 retorts, or approximately 3,750 tons of slab zinc a month. The Cherryvale plant's capacity is 5,000 retorts, or 2,250 tons of zinc monthly.

Probably the Steel company will buy its zinc in the form of Tri-State zinc concentrates. For the last two weeks Joplin concentrates have been selling at $43 per ton, the highest for several months. It is believed that the recent rather high shipments and purchases of ore and concentrates in the Tri-State field have been in part in anticipation of U. S. Steel's taking this large order for galvanized sheets, as the business has been in the world's market for some time, and came to this country finally largely because English mills were so tied up on Indian orders that they could not take on additional tonnage. To supply the slab zinc requires about 13,000 tons of Tri-State concentrates, or one week's output for the district at present rate of production.

The locust barrier, owned by the Argentine Government, is rented as required by farmers. The barrier is made by cutting No. 9 galvanized sheets into 18-in. lengths. These are supported by driving iron spikes into the ground and standing the sheets between rows of these spikes. A ditch is dug in front of the barrier, and the locusts are killed as they accumulate in this trench, by pouring on oil and burning them.

Equipment of Mohawk Mill for Regrinding Nears Completion

Mohawk, in the Michigan copper district, will resume hoisting in No. 1 shaft on or about Oct. 1, it is expected. Though the ground to the north of the shaft is not as rich as that to the south, in the direction of Nos. 4 and 6, the yield should average fully 20 lb. of copper per ton stamped and run through the concentrator.

The one completed regrinding unit in the Mohawk mill is giving satisfactory results on Wolverine rock, and slightly better than a pound of copper per ton of tailings is being recovered. A better yield will be possible on Mohawk rock, which is coarser and better adapted to regrinding. The second stamp head will be equipped with regrinding machines and tables by Oct. 1, and as soon thereafter as possible the remaining two heads will be supplied. By the first of the year all of the tailings should be undergoing regrinding.

United Western Has Ore on 300 Level at Oatman

Notable results have been achieved recently in development work in the United Western mine of the Oatman district in Arizona. The United Eastern vein, where crossed on the 300 level, has been found to contain ore assaying $4 a ton over a width of 16 ft. The management now intends to bail out the shaft to the 500 and to continue exploration from that level.

At the Gold Road mine of the United States S. R. & M. Co., drifting continues on the 300 level and stoping is being done on the first, second, third, and fourth levels.

Verde Central Has 5 Per Cent Ore at 1,200 Level

The Verde Central at Jerome, Ariz., has struck a new orebody on the 1,000 level. Details are lacking, but the ore is said to be of higher grade than any before discovered in the mine. The shaft, now passing through ore averaging 5 per cent copper, is down to the 1,200 level, where a station is being cut. The shaft is to be sunk 200 ft. deeper and a sump cut below that. Stations will then be cut on the 1,100, 1,300, and 1,400 levels, giving the mine a total of seven levels. The management expects the shaft sinking and station work to be completed by Nov. 1.

United States Vanadium Co. Builds Concentrator in Colorado

The United States Vanadium Co. has been organized to operate some extensive vanadium properties about 12 miles northeast of Rifle, Colo. The Rifle deposit differs materially from any other in this state, both in convenience of location and character of the orebody.

Instead of the ore being associated with carnotite, and found in small and erratic deposits, the Rifle discovery is in a blanket formation, and easy of access. The ore is unusually free from impurities, and the process of treatment, developed after extensive experiments at the Colorado School of Mines testing plant, is said to eliminate all objectionable elements.

A large mill is now under construction near the mines, and it is believed will be ready to treat ore during the coming month. A good profit is expected.

Many Dig for Silver Ore in Hamilton, Nevada, District

Hamilton, the old bonanza silver camp in White Pine County, Nev., is the scene of active prospecting and development. The Tonopah Mining Co. is driving a crosscut westerly in the Treasure Hill section to prospect the area between two big veins of lime. The company has a large group of claims under option.

The Aladdin company is expected to start exploration immediately. J. A. Wright, formerly in charge of company operations at Aladdin, is to direct the work. The first phase of activity will be to clean out the old Boston tunnel, undercutting a good ore showing on the property.

The Myra Divide company is planning to sink an incline shaft on a promising vein. Work on the Florence is confined to cleaning up the old Mammoth tunnel. Samples taken from open cuts on the surface immediately above the tunnel gave returns of from 17 to 25 oz. in silver.

The shaft of the White Pine Mining Co., which is under the control of Roy Rigsby and associates, has reached a depth of 35 ft., with good progress being reported.

W. J. Loring, general manager of the Plymouth Consolidated Gold Mines Co., is incorporating to take over four claims that he purchased at Hamilton some months ago. As soon as organization plans are completed, it is said that he will start active development work.

Shipments from the Grand Prize, which is owned by Ed Wilson and Ole Johnson, are going forward regularly with gratifying results.

New Company Plans Placer Mining on Cedar Creek

Irving Anderson, mining engineer of Wallace, Idaho, and associates have taken a bond on the property of the Cedar Creek Placer Mining Co., which includes the old Cedar Creek diggings, famous in the early days of Montana, and much virgin ground which the pioneer placer miners were unable to work with their primitive facilities. Some twenty years ago the ground was acquired by T. J. Lacasse, of Missoula, Montana, who organized the Cedar Creek Placer Mining Co. Under his management the old diggings were reworked by dredging. Later the Kansas City Commercial Co. took over the property, its purpose being to reach the virgin ground above the old diggings. Financial difficulties overtook the company before the objective was reached and the property reverted to Mr. Lacasse, who has now bonded it to Mr. Anderson and associates, who will operate as the Gallice Investment Co. Mr. Anderson states that there is two miles of virgin ground along the creek above the old workings, varying from 150 to 600 ft. wide, and that this will immediately be prospected, the results of which will determine the method to be used in working: whether by drifting or hydraulic. It is estimated that Cedar Creek produced $12,000,000 in the early days.

New Equipment for Potosina Mine, Pozos, Guanajuato

In the Pozos district in Guanajuato, Mexico, the Cia. Angustias, Dolores y Anexas has recently taken over the properties of Magdalena y Anexas. By this contract, according to reports, the Augustias company takes 65 per cent of the products of the mines to be operated under its direction.

Work has already started in the Potosina mine of the Magdalena company. Drifts and raises are being extended, track repaired, and the main shaft is being overhauled. The steel headframe has been raised 2 m., to allow headroom for new bins, an electric hoist is being installed in place of a former steam hoist, and the narrow-gage railroad is being extended from the main line to the vicinity of the Potosina shaft.

Work has been under way at a new property on the west slope of Cerro Pelon, the Noche Buene, denounced by Casto Iturbe and Tomas Guitierrez. The work is under the direction of Tomas Guitierrez, and is backed by the Fernandez interests, of Pachuca. The same interests are developing the Jilguero property, in the Charcas district, 30 km. to the northeast. Reports say that good ore is being encountered in the Jilguero development.

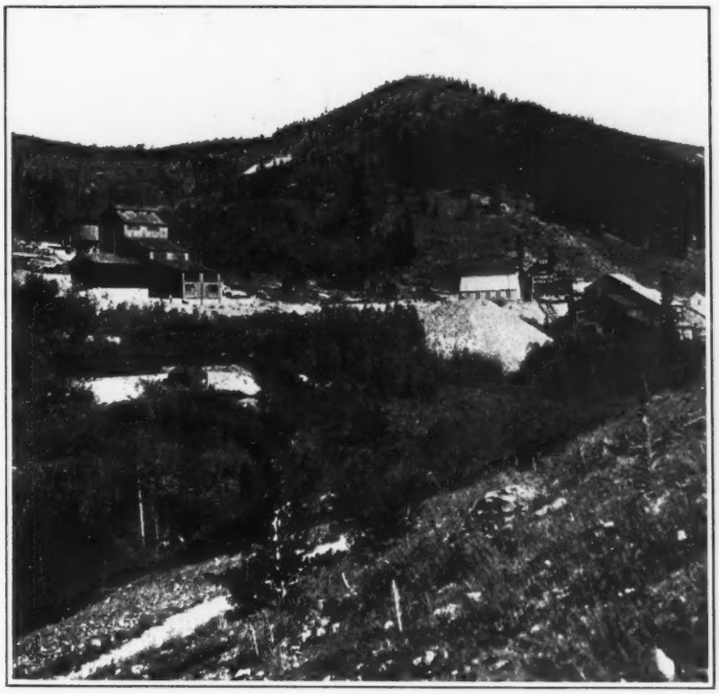
Tomas Guitierrez is also working the Eldorado property, including the Refugio, near Angustias, which has long been idle. The dumps are also being sorted and ore is sold to the Angustias company. Large lumps of low-grade ore thrown on these dumps in bonanza days are now in demand as pebbles for the tube mills.

Tonopah Divide Orders New Hoist for Midway Shaft

The Tonopah Divide Mining Co., of Tonopah, Nev., has ordered a new Nordberg hoist, which will be placed at the Midway shaft, and has started construction on a suitable headframe for deep work at the same shaft. It will be recalled that the Tonopah Divide absorbed the Tonopah Midway Company on July 12th, and it was announced at that time that funds of the Tonopah Divide company would be used for developing the Midway mine at depth, prospecting for the easterly continuation of the large and rich veins now being worked by the Tonopah Extension farther to the west. The old equipment at the Midway is inadequate, and it is necessary to purchase this new and heavier equipment for this purpose, and as soon as it is installed active underground work will be started.

New 20-Stamp Mill Being Built at Alleghany, Calif.

A 20-stamp mill is to be erected at the Yellow Jacket mine, at Kanaka Creek, Alleghany district, Calif. The first 10-stamp unit is now under erection, grading for the foundations having been started recently. S. E. Montgomery is in charge. The property is said to be owned by R. G. Gillespie, of Pittsburgh, Pa.



The "electric" smelter of the Evergreen Mines Co. is at the left

Plan to Smelt Copper Concentrate by Electricity in Colorado

Whether an "electric" smelter can be adapted to the reduction of complex ores in a commercial way is to be demonstrated by a plant which is nearing completion on the property of the Evergreen Mines Co. at Apex, Gilpin County, Colo.

The plant is designed for the reduction of copper concentrates first to a matte and then to blister copper, and the smelting installation will take care of approximately twenty-five tons daily.

The Evergreen property is developed to a depth of 800 ft., with over a mile of underground development. The mill is equipped to handle 100 tons of crude ore daily.

Cresson Development on Eighteenth Level Encourages Management

Shipments from the Cresson mine, at Cripple Creek, Colo., for August were approximately 10,000 tons, of an average value of about $16, practically the same as the preceding month.

Development of the eighteenth level, the present lowest productive point, is disclosing big bodies of ore as the new territory is opened up, and the management believes it will be fully as productive as the two levels above.

The shaft from the eighteenth level is now 50 ft. below what will be known as the twentieth level, and will be continued to the twenty-first, where a station will be cut, 2,475 ft. from the surface. Development work will then proceed from the stations at the nineteenth and twentieth levels. The new pump will be installed at the twentieth level station.

U. S. S. R. & M. Co. Absorbs Dredge Interests

The United States S. R. & M. Co. and the Hammon Consolidated Co., both of which have been active in optioning and drilling placer ground in the Fairbanks district, in Alaska, have consolidated their activities in that district under the name of the Fairbanks Exploration Co. Norman C. Stines, with headquarters in Fairbanks, is in complete charge of operations. It is indicated that operations so far have been encouraging and it is not at all unlikely that several large dredges will be installed. Much of the ground being drilled is "deep," and if the project goes through it will include the construction of a 100-mile ditch line to bring sufficient water from the Chena River for ground sluicing.

Mr. Stines will leave soon for a visit to Nome, where he will confer with company officials. G. A. Bigelow, engineer on the staff of the Hammon company, has arrived in Fairbanks to be in charge of operation while Mr. Stines is at Nome.

Graphite Manufactures Were Worth $2,184,609 in 1923

Establishments engaged primarily in the manufacture of graphite had combined output valued at $2,184,609 in 1923, an increase of 49.9 per cent over the 1921 output, according to returns just compiled from the census of manufactures for 1923. During that year the number of persons engaged in the industry increased 46.2 per cent, salaries and wages increased 48.6 per cent, cost of materials increased 53.8 per cent, and the value added by manufacture increased 46.3 per cent.

Washington News

By Paul Wooton
Special Correspondent

Importers Reap Benefit of High Tungsten Tariff

Supply From Old Stocks—No Domestic Production Despite 45c. Duty—No Current Imports

As a result of the 45c. per pound duty on the tungsten content of ores, prescribed by the tariff act of Sept. 22, 1922, American consumers are paying fully three times as much for their requirements of this essential material as are manufacturers in other countries. Prices for Chinese ore in June, 1923, were $9.89 per unit. The cost of the ore was $2.75. The difference, $7.14, represents the duty. Thus, the American public is being called upon to pay a huge bill, which ramifies into thousands of commodities and increases their price to the ultimate consumer. At the same time, this duty of 45c. has encouraged the domestic production of tungsten only to the extent of a small output gouged from developed properties—reserves which might be of great value to the public were the country cut off from foreign sources of supply. The chief beneficiaries of the tariff were the importers, who piled up several years' requirements, and now, with no fear of domestic competition, are selling the material for the highest dollar the tariff wall will allow.

The world production of tungsten ore (concentrates of 60 per cent WO_3 content) prior to the war was from 7,000 to 8,000 tons per year and came principally from the following countries in the order of importance: 1, Burma, Siam and England; 2, Spain and Portugal; 3, Australia; 4, Argentina, Bolivia, and Peru; 5, United States.

The need for ferrotungsten for the manufacture of high-speed tool steel was enormously increased during the war. The average ore production, 1915 to 1918 inclusive, was over 22,000 tons. The bulk of the increase was provided by China. The output from Burma was tripled, as was also that from Spain and Portugal, and the United States production was quadrupled. South American production was four to five times its normal pre-war output. The momentum gained by these increased outputs carried the mining industry through 1919, when production was roughly double the amount of consumption.

It is believed that at the close of 1918 there existed excess stocks representing the tungsten content of roughly 8,000 tons of ore. This surplus was increased during 1919 to nearly 18,000 tons, at which figure it continued to the close of 1922.

The domestic tungsten mining operations of the United States before the war employed about 100 men, none of whom were dependent on tungsten mining for a living, as the production was from states containing diversified mining operations from which the tungsten miners were actually drawn. Southeast Asia in 1922 supplied 92 per cent of the world's aggregate output of tungsten ore.

Since the 1922 tariff went into effect, United States prices have been about $8 per unit for 60 per cent concentrates. Whereas 1,655 tons were imported in 1922, prior to the tariff act, only 10 tons were imported subsequent thereto, and none has been imported in 1923 or the first seven months of 1924.

Vantage Makes 25 Tons Lead and 15 Tons Zinc

THE Vantage mine, near Picher, in the Joplin-Miami district, which has long been one of the best lead producers in this field, in which lead is only of secondary importance to zinc as a rule, has recently established a new record in production of the heavy metal. In nine hours last week the Vantage company at its No. 1 mill produced 25 tons of lead concentrate. In the same time it produced an additional 15 tons of zinc concentrates, making 80,000 lb. in all for the nine hours. O. A. Sneed is superintendent.

War Minerals Relief

War minerals relief claims in which awards had been made recently amounted to $25,334.

The largest claim was for $12,180 to the Boulder Tungsten Production Co. of Boulder, Colo. Other claims allowed ranged from $858 up to $4,667. The claimants and the amounts awarded follow by states:

Arizona

R. R. McDonald, Baylor Holmes and W. H. McCarthy, Kirkland, Ariz. $1,948.85

California

C. C. McDonald, Igo, Calif $1,368.75
Irvin Carpenter, Chico, Calif. 858.09
Neely Brothers, San Francisco, Calif. 4,311.30

Colorado

James Daniels, Leadville, Colo.... $4,667.38
Boulder Tungsten Production Co., Boulder, Colo..... 12,180.16

Bureau Engineers Recommend Government Reduction Plant in Alaska

AFTER an unofficial survey of the mineral resources along the government's Alaska railroad, engineers for the U. S. Bureau of Mines have recommended to Washington that an ore-sampling plant and reduction works for treating free-milling ores by plate amalgamation, and for concentrating base ores be established by the government at Anchorage.

It is reported that there are free-milling gold prospects in the railroad belt sufficient to supply a small plant and that lessors are ready to enter the field as soon as they are able to dispose of their product. Such a step would be an innovation for the U. S. Government.

Several European Countries Want Aluminum-Bronze Coins

American Manufacturers Do Not Care for the Business—Commerce Department Urges Bidding

Several of the smaller European countries are asking for bids for subsidiary coins. The demand seems to be for aluminum-bronze and nickel coins. No recent calls have been made for silver coins. It develops that manufacturers of coins and coin blanks in this country are not inclined to bid on coins involving the use of an aluminum-copper alloy. They have found in their practice that such an allow does not roll successfully. They have suggested that an effort be made to induce the governments submitting the bids to alter their specifications so that nickel may be used.

The Mineral Division of the Department of Commerce is hopeful that American manufacturers may be induced to bid on the type of alloy called for in the specifications, as this will permit the use of metals produced in the United States. Even if the governments concerned could be induced to change over to nickel, which is regarded as very doubtful of accomplishment, it would mean the use of a metal not produced in any district of this country.

The department is informed that the French are particularly well satisfied with their bronze coins. They seem to have overcome any difficulty in the workability of the alloy. Among the countries calling for bids at this time is Bulgaria, which is asking for quotations on 85,000,000 coins made from an alloy consisting of 90 per cent aluminum, 8 per cent zinc, and 2 per cent copper. Neither the Bureau of the Mint nor private American manufacturers care to undertake the making of coins from an alloy thus composed. An order for 65,000,000 coins for Bulgaria went elsewhere. No American bids were submitted, because of objection to the alloy. Though it is regarded as possible that slight alterations in the comopsition of the alloy might be arranged, it is not thought probable that Bulgaria or any other country would be willing to make a change that would alter the appearance of a well-established series of coins.

Engineer Flies Three Hours; Saves Ten Days in Alaska

It is becoming a common occurrence for mining men to use the airplane for trips between different camps in the interior of Alaska. A local company has two modern airships in constant service out of Fairbanks, and thus the mining districts of Tolovana, Kantishna, Salaha, Circle City and other points on the Yukon are brought within a few hours' travel of Fairbanks.

Norman L. Wimmler, placer mining engineer for the U. S. Bureau of Mines, recently flew from Fairbanks to Eagle, an air-line distance of about 200 miles, in less than three hours. This journey by boat would consume ten days, and his summer work is thus expedited by that amount of time.

London Letter

By W. A. Doman
Special Correspondent

Fall in Gold "Premium" Arouses Anxiety on Rand

Production Costs Do Not Come Down—Low-grade Mines on Verge of Loss—Dolcoath Sinks

London, Aug. 26—The rise in the price of sterling and the consequent fall in the gold premium are causing a good deal of anxiety on the Rand, where nine mines, including the East Rand Proprietary, are beginning to fear difficulties. It was hoped that the effect of the loss of premium would be countered by a reduction in working costs. Somehow, however, these costs cannot be got down to the level expected. The large rich mines are able to reduce their expenses, but for the lower-grade properties the matter is less easy.

Although the Broken Hill Proprietary Co. (N. S. W.) has had its first year's continuous run with its steel works at Newcastle, and made a substantial profit as against a heavy loss, labor troubles are not yet over. According to a cable dispatch an agitation is in progress for a new agreement on wages and hours. The steel works could earn handsome profits, and even export its products, if labor would only give it a chance. But in Australia, more than anywhere else apparently, it is difficult to get labor to see its best interests.

The shaft at the Dolcoath mine, in Cornwall, on the Roskear section, has reached a depth of 357 ft., and work is proceeding satisfactorily. The Roskear section has never been operated; only surface workings have been undertaken. I am informed, however, that indications are such that there will be a revival of the original prosperity of the company. The Dolcoath is one of the oldest mines in the duchy, and with tin at its present price it may be expected to be worked at a profit.

Work at the South American Gold Areas (Brazil) is temporarily held up by the delay in forwarding supplies from Rio owing to the revolutionary movement. Apart from this, developments are reported to be satisfactory.

Much is expected of the silver-lead find at Mount Isa, in Queensland, where, according to the government geologist, the occurrence of extensive and widely distributed bodies of ore is unique. While not dogmatizing, the official is optimistic as to the metals to be recovered and suggests investigation of the deposit at lower depths. Much interest is shown over here in regard to the discovery, as for some years, according to an authority, no important finds of lead have been made. The consumption, he says, is increasing and will increase, while the production is no larger than pre-war.

Recently a cable dispatched was published concerning a concession for smelting zinc, silver, lead and copper at Tyutikha Bay, on the rivers Yaodzy and Okhabe, in Eastern Siberia. For a payment of £20,000 the Soviet Government has given the concession to Briner & Co., of Vladivostock, in which the Becos Engineering Corporation, of London, is interested. The concession is for thirty-six years; the concessionaires must spend £6,000 annually for five years, and give the Soviet Government the sole right to purchase the whole output.

Wonders of Copper Displayed at Wembley

ON ONE stand in the Palace of Engineering at the British Empire Exhibition, Wembley, there is an example of almost everything that has ever been made out of brass and copper. Side by side are a bobbin of wire no bigger than an ordinary thread bobbin which has wound round it twenty miles of the thinnest wire that has ever been drawn, and another bobbin weighing a ton, which holds seven miles of the thickest copper wire.

In the front of the stand the smallest tube ever produced is shown. The hollow part of this is so small that it is impossible for it to take a hair. This tube is 450 ft. long, and to show that it is hollow air is pumped through it into a bowl of water. One old lady, seeing the bubbles rising in the water, asked the attendant how the water was boiled.

Colored aluminum is an entirely new product which is exhibited for the first time. This has opened out new avenues of business, and it is very likely that automobile bodies of the future will be manufactured of this colored aluminum.

Surplus Labor in Porcupine District in Ontario

NEWSPAPERS published in the Porcupine district in Ontario are issuing warnings that there are more unemployed men in the camp than can be absorbed. It is estimated that there is a surplus of 500 men in the district, and with some large construction jobs being finished in the near future, this number may be added to. During the next few months construction work on the Kirkland Lake railway will be completed, as will also that on the South Lorrain branch and a large part of the laboring work on the Hollinger power plant will also be finished.

Though the mines themselves are in excellent condition and are turning out more gold and employing more men than they have ever done before in their history, the general depression throughout the country has resulted in a large number of men going to the mining camps, which represented one of the bright spots on the continent. There is always an excellent opportunity for skilled miners, but men of little experience in the mining business are finding it difficult to get employment.

Australian Letter

By Our Special Correspondent for Queensland

Mount Isa Shares Drop From £40 to £28

Sudden Resignation of E. C. Saint-Smith Said To Be the Reason—Recent Developments Encouraging

Brisbane, Aug. 3—The latest news from Mount Isa indicates that developments at this silver-lead field continue to be highly satisfactory, especially in some of the mines of the Mount Isa Mines, Ltd. Particularly, very high-grade ore has been found in what is known as the Gairns area, and testings at depth on the Black Star lode, in that area, give promise of a good tonnage of ore of payable quality. Active work is now being carried on in nineteen shafts on the leases of this company, and six of these are being operated at depth below 80 ft. Nearly a hundred men are being employed on this company's leases. To make provision for the purchase which has been effected by the Mount Isa company of the leases and options held by the Mount Isa South Co., the capital of the former has been increased from £450,000 to £800,000.

A mild sensation has been caused, in connection with Mount Isa interests, by the resignation, after only six months' service, of E. C. Saint-Smith as mine superintendent of the Mount Isa company. Following on that event the shares of the concern, of a nominal value of £20 each, have fallen from more than £40 to £28. The chairman of the company, when asked for the reason for the resignation, said that Mr. Saint-Smith asked for additional assistance, as well as for some better conditions, which the directors did not see their way to grant. He adds that for the good work which the superintendent has done he has been granted a further six months' salary.

In their financial year ending in 1923 the Mount Morgan company, although being helped by special government concessions in railway rates amounting to £1.100 per week, experienced a loss of £70 000.

In the Stanthorpe district during the last quarter there has been a marked increase in the production of arsenic, but the product is not, as was expected, being exported to America to assist in the destruction of the boll weevil. Instead, most of it is being sent to chemical works lately established at Wallangarra, on the railway 25 miles from Stanthorne, and there manufactured into what is described as an improved prickly-pear poison. The prickly-pear pest is probably as great a menace, proportionately, to Queensland and other Australian states as the boll weevil is to the cotton industry of the United States. The poison mentioned is a patented preparation, consisting of 20 per cent of pentoxide, which is said to be the most potent pear poison known, and 80 per cent of sulphuric acid. A recently appointed Prickly-Pear Commission has bought the whole of the output of the Wallangarra works for twelve months.

Situation at the Mines

By Arthur B. Parsons
Assistant Editor

METAL MINING is one industry that certainly is not depressed. Whatever the future may have in store, September finds the mines, with the single exception of those in the Lake Superior iron region, producing at good capacity and, in general, making money. Reservation also should be made to the effect that copper producers still concede room for further improvement in their situation. Nevertheless, from Butte comes the intimation that Anaconda will reopen some of its idle copper mines with the floating of the German loan, thereby increasing output above the 15,000,000 lb. monthly that has been the rate for six months. Whether this will be the signal for a rush for increased production from other copper mines in Utah, Arizona, and elsewhere, remains to be seen.

Sundry Increases in Copper Output Rates

The potential output of the copper industry is much above the present rate, but any marked increase will threaten the market price which the large interests have been nursing so carefully. The temptation to cut costs by accelerating production is strong. At the current price of 13.25c. all but a few can more than make ends meet. Reliable production figures are hard to get, but the increases seem to be numerous and decreases are scarce. The Union Minière, African "copper menace," established a new high record of 18,861,570 lb. in July, and unless Chile or Utah has quietly increased over its reputed rate the Katanga property is for the time being the leading producer in point of output. In Michigan, Copper Range and Mohawk are increasing; Phelps Dodge appears to be gaining ground both in Arizona and in Mexico; and New Cornelia, Calumet & Arizona, and United Verde, in Arizona, are making more copper than heretofore. New Cornelia output in August was 5,627,261 lb., against 4,427,373 in July. Granby Consolidated is running its 1,500-ton mill at maximum capacity for the first time, and output should be increasing. The concentrate, incidentally, is being sent to the A. S. & R. plant at Tacoma, following the failure to treat it satisfactorily at Anyox. All operations at the Kennecott mines, in Alaska, were suspended on Aug. 3 on account of a serious fire in the power house. Full production probably will not be resumed before November. East Butte's 500,000 lb. production has been extinguished by shutting down.

Lead smelters in Utah are again smelting more ore. Six furnaces each at Murray and Midvale and two at Tooele are in blast, reflecting increased custom shipments. There, perhaps more than anywhere else, activity synchronizes with fluctuations in the lead market. At the current price of 8c. smelter receipts are larger than they were during the summer. Two lead furnaces are in blast at the Bunker Hill smelter, in Idaho, in consequence of large shipments from Keno Hill, in Yukon territory, as well as greater activity in Cœur d'Alene and near-by tributary districts. Colorado lead-ore production, due to gradual depletion of profitable orebodies, is smaller than it has been. A number of enterprises are under way, however, that may develop important tonnages. The best bet is the Graham Park Basin project, at Leadville, where after a year's pumping the Deep Mines company is ready to develop ore. Southeast Missouri continues, without fuss, to produce more lead than any other district.

Missouri Zinc Output Climbs

Zinc output in the Joplin-Miami field is at its highest point for many months—more than 14,000 tons of 60 per cent concentrate per week. Smelting companies are competing for "jack," and with the slab zinc market at 6.25c., producers are prosperous. Several mines that were shut down to curtail production in July are again operating, and still further increases in output are expected. A fire in the Elm Orlu mine, at Butte, last month cut August production by about 25 per cent, but the Butte & Superior and Anaconda zinc mines operated normally. The leasing of the property of the Shasta Zinc & Copper Co. at Bully Hill, Calif., by the Glidden company marks another attempt to solve a "complex ore" problem. Zinc oxide will be the principal product, with copper matte as an incidental. Still another new producer is the Combined Metals Co., which is floating selectively zinc-lead-silver ore from Pioche, Nev., at a new plant at Bauer, Utah. The American Zinc, Lead & Smelting Co., at Mascot, Tenn., and the New Jersey Zinc Co., at Franklin Furnace, are producing regularly.

Silver miners continue to thrive on a relatively high market around 68⅜c. Not fewer than six development enterprises are active in the old Hamilton district, in White Pine County, and the Mono Mining Co. will build a 100-ton cyanide plant at its Silverado mine, in Mineral County, Nev. In Tonopah rich discoveries in the most westerly mine workings have started much claim staking, and various sales of claims are reported. Silver mining in Tombstone, Ariz., is stimulated by higher prices. The Old Dominion mine, in Washington, is increasing silver output from a bonanza oreshoot, and a new flotation plant for silver-lead ore has just been completed by the Hewer Mining Co., at Lakeview, Idaho. The completion of the new milling plant of the Chief Consolidated at Eureka, Utah, will swell silver production there. Output at Cobalt and neighboring districts in Ontario is at the rate of 750,000 oz. per month. The discovery of high-grade ore at the Canadian Lorrain property forecasts another producer for South Lorrain.

Gold Producers Thrive

Gold mining likewise is good. In the Porcupine district output is about $1,600,000 per month. The McIntyre Porcupine has gone on a 20 per cent dividend basis and at the same time has announced that it will sink a five-compartment shaft to 4,000 ft. The cost, including equipment, will be $1,600,000. The Portland, at Cripple Creek, is now milling 700 tons of ore per day, or double the rate of 1923. In Nevada the small gold camp of Jarbidge is making a record production with the Elkoro and Bluster Consolidated mills both in operation. Output in both lode and placer mines in California is steady. Incidentally, the continued improvement in sterling exchange and the coincidental shrinking of the gold "premium" is threatening profits of the small-margin gold producers on the Rand, in South Africa.

Offsetting the lethargy of lead-silver mining in Colorado are the resumption of operations by the Climax Molybdenum Co., which, after five idle years, has started milling 200 tons of ore at its Lake County property; and the construction of a new concentrator by the United States Molybdenum Co. near Rifle. The company has a large deposit of rich ore that it expects to exploit at a good profit.

The nickel-mining situation has been simplified by the suspension of operations at Sudbury following liquidation by the British America Co. This leaves the business in the hands of the International and Mond interests.

In the Lake Superior iron mines current production is curtailed and the expected expansion in Lake shipments has failed to materialize. The gross tonnage for the year will be approximately 45,000,000, compared with 60,000,000 last year. The outlook for activity in underground mines during the winter is not good, as stockpiles are generally large. The Iron Mountain mine, in Missouri, suspended operations early in September.

The labor situation is ideal for the mine operator. In the Michigan copper country underground forces are being augmented steadily in spite of a comparatively low wage scale; and from northern Ontario districts come warnings to miners in other districts that there is already a surplus. This is the consequence partly of the curtailment in nickel and iron mining, and partly of the completion of various railway and other construction projects. The adequacy of the labor supply in mining districts throughout the United States may be in large measure accounted for by the prevailing mild industrial depression. Talk of wage reductions has not been heard as yet, but winter may bring some such action.

Men You Should Know About

G. F. Loughlin is making an extended Western trip.

Robert H. Bedford, of the North Star Mines, is in San Francisco.

Donald F. Irvin is developing details in ore-refinery practice at Martinez, Calif.

Philip S. Smith and his party have arrived at Nome and will sail soon for Seattle.

K. C. Heald has begun his duties as associate professor of geology at Yale University.

F. Carnegie has resigned from the management of the Foley mine, in western Ontario.

H. T. Hamilton, consulting mining engineer, has returned to San Francisco from an Eastern trip.

S. H. Brockunier has returned from oil examinations in Kentucky to his home in Lowell, Mass.

George H. Collins, mining engineer of Denver, was recently in San Francisco en route to Los Angeles.

Arthur A. Schmidt, consulting engineer for the Western Precipitation Co., is in Europe on an extended pleasure trip.

T. C. Baker, assistant manager of The Mexican Corporation, was a recent visitor to the company's properties on the Comstock Lode, in Nevada.

J. A. Reid, of the O'Brien, has been appointed consulting engineer of the Bingo property, in Manitoba, and will make his headquarters in Winnipeg.

H. C. Carlisle, mining engineer for Tonopah Mining Co., has just returned from Sonora and Lower California, Mexico, to his office in San Francisco.

A. A. Baker and his party of geologists have completed work in the Tongue river district of Montana, and moved to the vicinity of Winifred, Mont.

Douglas Mutch has resigned his position as manager of the Night Hawk Peninsular mine, Porcupine, and **Walter E. Segsworth,** consulting engineer, is in charge.

Dr. Walter Harvey Weed is accompanying **Charles V. Bob,** president of the Engineer Mines, Ltd., and a group of capitalists, to the famous Engineer gold mine, near Atlin, B. C.

R. H. Humphries, mining engineer, manager of a dredge in the Cache Creek district, was recently married at Fairbanks, Alaska. His bride was Miss Wilma Carlson, of Fairbanks.

John Underwood, foreman at the Hilltop mine near Douglas, Ariz., fell 84 ft. to the bottom of a timber chute recently, breaking both legs and injuring his back. He is expected to live.

F. S. McNicholas has resigned his situation as mining engineer with the Anaconda Copper Mining Co. to accept a similar position with the Butte & Superior Mining Co. in Butte, Mont.

Louis Hirshler, of New York, has been appointed sole agent of the Société Anonyme de la Vielle Montagne, of Belgium, for the purchase of zinc concentrates in the United States.

J. Mackintosh Bell, director of the Vipond Consolidated and the Keeley silver mine, accompanied by **F. H. Hamilton,** of London, a leading official of both companies, is in the Porcupine district.

Warren S. Wynn, who has been working for the Miami Copper Co. as underground transitman, has left Miami for Lawrence, Kan., where he expects to complete his course in mine engineering.

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Senator Tasker L. Oddie

Senator Tasker L. Oddie, of Nevada, will discuss the influence of exchange on foreign trade, and the position of the gold standard in various countries, before the meeting of the Nevada Bankers' Association on Sept. 18.

R. B. Lamb has gone to London on professional business and will return to Toronto about Oct. 1. He recently completed a two months' inspection of the Stewart and Slocan mining districts in British Columbia.

Dr. S. C. Lind chief chemist, U. S. Bureau of Mines, has resumed direct control of research on radioactivity, the Bureau's radium laboratory having been transferred from Reno, Nev., to Washington, D. C.

Courtenay De Kalb was in New York recently and has returned to Arizona. He points out that the Moroccan revolt against Spain has as its explanation a conspiracy for the possession of the iron mines of Spanish Morocco.

Colonel Henry H. Armstead, president of Canadian Mines Merger, Ltd., left New York recently to make an inspection of the holdings of the corporation at Adamont, Keen and Ferguson, in the vicinity of Kaslo, B. C. He expects to be gone about three months.

P. G. Spilsbury, of Phoenix, Ariz., and president of the Arizona Industrial Congress, is in Washington attending meetings of the Interstate Commerce Commission, in connection with the merger of the El Paso & Southwestern and the Southern Pacific interests.

Ernest W. Ellis, of the Idaho School of Mines staff, has been engaged in an investigation of the comparative merits of classified feed, screen-sized feed and natural feed in table concentration. **Alfred L. Anderson,** of the Geological Department, is engaged in preparing a report on the "Mica Deposits of Eastern Latah County."

Henry L. LeFevre has sailed for Puerto Barrios, Guatemala, where he will conduct drilling tests in a placer field that has been little known heretofore. Mr. LeFevre last spring took options on several large pieces of ground on the Bobos River about fifty miles from the seaport of Puerto Barrios. This work is being done for **A. C. Ludlum,** of New York, who has just installed an 8-ft. all-steel electrically driven dredge and a hydroelectric power plant in the vicinity.

William Sulzer, former Governor of New York, is spending the month of August in Alaska looking after his various mining properties. He was accompanied to Cordova by **C. O. Lindberg** and **A. D. Storke,** mining engineers of Los Angeles. These two engineers will outfit at McCarthy to visit some copper property held by Mr. Sulzer in the White River country, back of Kennecott. Mr. Sulzer continues northward to visit the Chandalar Gold Mining Co. near the headwaters of the Chandalar River.

Obituary

J. M. Jimerson
H. Eudy

An Appreciation by N. H. Emmons, 2nd

On. Aug. 28, in the mine of the Annapolis Lead Co., at Annapolis, Mo., J. M. Jimerson and H. Eudy met death by a fall of ground. Jimerson was the mine captain; Eudy one of the most experienced roof men. Both were that firm type of true American manhood who do not hesitate to go into the most dangerous situations when duty calls. During the nine months I worked with Jimerson, he as mine captain and I as superintendent, I had the opportunity to learn and admire his many firm traits of character. He was a young man, about thirty-six years old, and had worked as a miner since he was a boy, in the mines of the National Lead Co. and the Federal Lead Co., in the Flat River district of Missouri. For three years he had been in charge of the high backs in one of the Federal Lead Co.'s mines, and he was proud of the record that no serious accident had ever happened in the workings for which he was responsible. He was honest and straightforward, enthusiastic about his work, reckless with his own safety, but most careful with his men—a leader not a boss, always in front and lending a helping hand whenever there was trouble. He was a true mine captain, and died doing his duty—a man we all delight to honor.

Recent Technical Publications

Reviews, Abstracts, and References

For the Chemist

Metallurgical Analysis. By N. W. Lord and D. J. Demorest. Fifth Edition. McGraw-Hill Book Co., New York. Price $4.

That Lord and Demorest's "Metallurgical Analysis" should have run through four editions since the first thin volume appeared in 1893 is sufficient proof of the practical value of a well-arranged compilation of this kind. The fifth edition, just issued, is, like its predecessors, frankly a recipe book—a handy volume for students and works chemists containing directions for determining most of the elements such as may be required in the usual fields of commercial metallurgical analysis—that is, in the evaluation of raw materials and products in accordance with present-day specifications. It is not an exhaustive treatise and would be of little use to the research analyst except as a reminder of the details of ordinary methods. Nearly all of the methods described are well known and well tried; many of them are lifted practically bodily, with due credit, from the works of other writers. With few exceptions the selection has been judiciously made.

The new edition contains 130 pages more than the fourth. Many of the older methods have been modified and in part rewritten. A little more explanatory matter has been added in each chapter regarding the applicability of the methods. New chapters have been added on coal calorimetry, gas calorimetry, fire assaying, and electrometric titration. The chapters on water analysis, alloy steels, and gas analysis have been revised and rewritten, as, indeed, is necessary in view of the progress that has been made in these branches of analysis within the last few years.

The first twenty chapters deal mainly with analysis pertinent to iron metallurgy, covering the subject fairly thoroughly within the limits above mentioned. The remaining twenty-six chapters cover all the rest of the broad field of metallurgical analysis. They are necessarily more condensed and the selection of methods is neither so wise nor so broad as in the first twenty chapters; nevertheless, with the possible exception of the chapters on electrometric titration and fire assaying, they contain sufficient information to give the student a good view of the field and the works chemist practical methods for the analysis of many materials.

Any book covering such a broad field within the limits of 472 pages must necessarily be condensed; the language, therefore, is the patois of the laboratory, comprehensible enough to those who understand the dialect, but not a model of clear expression, and, on the whole, not conducive to clear thinking on the part of the student. For example, on page 33, referring to the preparation of a saturated solution of mercuric chloride—"Keep an excess of salt in a bottle and fill it up with water from time to time," and, on page 34—"Pulverize the ore in an agate mortar until it is so fine that no grit can be felt between the teeth." Although such expressions convey the idea intended, they do not educate students to express themselves clearly.

On page 89 is the heading "Precipitation of the SO_3 by $BaCl_2$." This reviewer respectfully submits that the feat has never been accomplished.

In the directions for standardizing bichromate solution by pure iron wire, now an obsolete procedure, given on page 32, the author directs that the work shall be done as directed on page 38 for the standardization of permanganate solution, but on page 33 he goes ahead with a careful description of the iron-wire method, mentioning the necessity of destroying carbonaceous matter by first dissolving the wire in nitric acid and then evaporating to fumes with sulphuric acid. The directions on page 38, however, do not include this precaution or any other for the destruction of organic matter. The two methods would be likely to give quite different standards and to confuse an inexperienced operator.

In the chapter on copper analysis, the five-gram method for the determination of copper in refined metal is described in detail, but the far more accurate ten-gram method now used in all copper refineries is omitted.

For the determination of impurities in refined copper the method given directs that 25 grams of sample be taken. The impurities to be found in present-day wire-bar copper are so minute that they might be missed altogether; they certainly could not be determined with the necessary accuracy on this small charge. Present practice requires considerable modifications of the method given.

The method for uranium in steel and ores, given on page 162, is useless when vanadium is also present.

The chapters on electrometric titration and on fire assaying are too brief and condensed to describe adequately these important operations, but the many references to books and articles make up for the deficiencies in the text.

Information concerning the relative value of methods or the degree of accuracy which may reasonably be expected from them is conspicuously absent; much is left to the instructor regarding this important feature, and the works chemist must use discretion in choosing among several processes.

The general arrangement is excellent, and the amount of information covering modern methods for metallurgical analysis is amazing; little of it is misleading and most of it will prove useful to the busy works chemist. The author's confidence in the practical usefulness of this new edition expressed in his preface will, I believe, be justified.

A. M. SMOOT,
Vice-President and
Technical Director,
Ledoux & Co.

Patents

Petroleum—No. 1,503,476. Aug. 5, 1924. W. L. Childs and L. A. Godbold, Houston, Tex., assignors to Hughes Tool Co., Houston. A drilling apparatus combining a well casing, a rotatable drill stem, a pump, connecting pipes, and valves.

No. 1,503,652. Aug. 5, 1924. C. W. Howe and J. J. Robertson, Ardmore, Okla. An oil-well pump.

No. 1,503,782. Aug. 5, 1924. John Barnes, Burkburnett, Tex. A packing box for oil wells.

No. 1,504,091. Aug. 5, 1924. C. C. Scharpenberg, Bakersfield, and L. G. Gates, Whittier, Calif. An oil-well pump.

No. 1,504,208. Aug. 12, 1924. P. F. Brine, Boston, Mass., assignor to Oil Wells Renewal Co., Chicago. An electrical heater for oil wells.

No. 1,504,299. Aug. 12, 1924. J. M. Wolfe, Oil City, Pa. A post-free and beam-free oil-well pumping rig, devoid of support by the oil-well casing.

No. 1,504,759. Aug. 12, 1924. T. W. Holley, Ranger, Tex. A well-drilling rig.

Mine Shovel—No. 1,504,427. Aug. 12, 1924. R. S. Butler, Joplin, Mo. A mine shovel comprising a cylinder, a pair of pistons, piston rods, and a pivotally mounted shovel connected to one of the rods to control its forward and rearward movement, the other piston rod being connected with the shovel to swing it on its pivot.

Metallurgy of Arsenic—No. 1,504,627. Aug. 12, 1924. J. G. Lamb, Denver, assignor to American Smelting & Refining Co., New York. Finely ground native raw pentavalent arsenic-bearing ore is treated with a 50 per cent solution of caustic alkali for the purpose of making a water-soluble arsenate. Patent No. 1,505,648, issued to the same applicant and similarly assigned, relates to the production of calcium arsenate entirely from soluble arsenic, the process consisting in forming an alkaline solution of a normal salt of arsenic, entirely free from acid arsenates, and adding calcium hydroxide in the form of a suspension to transfer all of the arsenic acid of the neutral salt into an insoluble arsenate.

No. 1,505,718. Aug. 19, 1924. C. P. Linville, Elizabeth, N. J., assignor to American Smelting & Refining Co., New York. In producing arsenates from nickel speiss, the speiss is roasted in the presence of sodium carbonate in excess of the amount necessary to convert the arsenic present into an arsenate, and the roast dissolved with water to obtain a solution of tri-sodium arsenate, the other metals being obtained in a residue substantially free from arsenic.

Drilling—No. 1,504,852. Aug. 12, 1924. W. W. Wright, Downey, Calif. Design for a rotary drill bit.

No. 1,505,586. Aug. 19, 1924. H. J. Corley, Thompson Falls, Mont. A supporting device for rock drills.

No. 1,506,119. Aug. 26, 1924. C. C. Hansen, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. A rotary cutting bit for a core drill.

New Machinery and Inventions

New Two-cycle Double-acting Diesel Introduced

Designed Primarily for Marine Uses But Expected to Compete With Steam Power Machinery Over Much Wider Range Than Hitherto

A NEW DESIGN of two-cycle, double-acting Diesel engine, considered by the manufacturer to represent the greatest advance in the art yet made in America, has been announced by the Worthington Pump & Machinery Corporation, of New York. The new engine combines a fuel economy comparable with that of the best existing types of Diesel engine, it is claimed, with dimensions, weight and construction cost per horsepower approaching those of reciprocating steam machinery.

Another feature claimed for the design is that the horsepower per cylinder can from all indications be carried to a higher value than any yet attained in Diesel engines, thus increasing the field of possible usefulness of Diesel-type power, and making it an active competitor of steam power machinery over a much wider range than hitherto. The first unit, built in the Buffalo plant of the Worthington corporation, is conservatively rated at 600 to 800 hp. for a single cylinder unit, at speeds of 90 to 120 r.p.m.

The new engine was wholly designed and built in America, and is said to owe nothing to European patents or ideas developed abroad.

The immediate inspiration for the effort that has resulted in the design of the new engine was the alleged need of an improved Diesel engine for ship propulsion. It is common knowledge that for the past five years, the problem of disposal of the United States war-built merchant fleet, which is the major portion of the entire problem of the American merchant marine, has defied solution.

The Shipping Board has long realized, and has convinced Congress, that the only hope in this situation lies in the conversion of these idle steamships into motorships, which, as is well known, can operate profitably at rates well below the profit level for steamers.

The difficulty has been that existing types of Diesel engine require so much more space and weight per horsepower than the steam machinery they were expected to replace, that their installation involves expensive structural changes, and also, as a rule, the sacrifice of some of the ship's deadweight capacity for cargo, besides the very heavy first cost of the engine itself.

It became evident that the situation demanded a new type of engine, designed to overcome the handicaps inherent in the character of existing Diesel machinery. The problem before the Worthington engineers, therefore, was to produce an engine with all the advantages of the Diesel engine in fuel and general operating economy, but approaching in dimensions, weight and speed per horsepower closely enough to steam machinery to permit to be substituted for such machinery in ships already built, at no prohibitive cost either for the engine or for the job of installation.

An additional point of great importance to marine engineers was that of manoeuvring qualities. A marine engine must be capable of being started, stopped and reversed quickly, and with ease and certainty of control. In this particular is to be found one of the reasons why the reciprocating steam engine has so long held its ground in competition with both the steam turbine and the Diesel engine.

The leading collaborators in the long research, now concluded, were O. E. Jorgenson, a Diesel engineer of international reputation, for the past five years a member of the Worthington technical staff, and Dr. C. E. Lucke, professor of mechanical engineering, Columbia University, New York.

The basic principle underlying the new engine may be briefly stated to be: In the four-cycle Diesel engine one stroke in four is a power-stroke; in the two-cycle engine one stroke in two; in the new engine every stroke is a power stroke. Its working cycle, therefore, is virtually the same as that of a reciprocating steam engine.

The principle, of course, is not a novel one, but mechanical difficulties, chiefly concerned with the complicated heat stresses in the cylinder of a double-acting engine, have hitherto interfered with its successful application. The success of the new design lies in the manner in which the problems of expansion and of heat removal are solved.

Once the major problem is overcome, the great advantages of the double-acting type are evident. The balance of the moving parts, for example, is greatly simplified, and the weight saving, not only from the manner in which the required power per cylinder is distributed through four strokes instead of being concentrated in one, but also from the decreased provision needed to care for the momentum of moving parts, and in other ways, is obviously great.

The cylinder of the new engine might be described as composed of two single-acting cylinders, opposed end for end and working in opposite directions, their respective pistons flanged to the same rod, the scavenging and exhaust ports, cooling water circulation and expansion provisions of the two being virtually independent of each other.

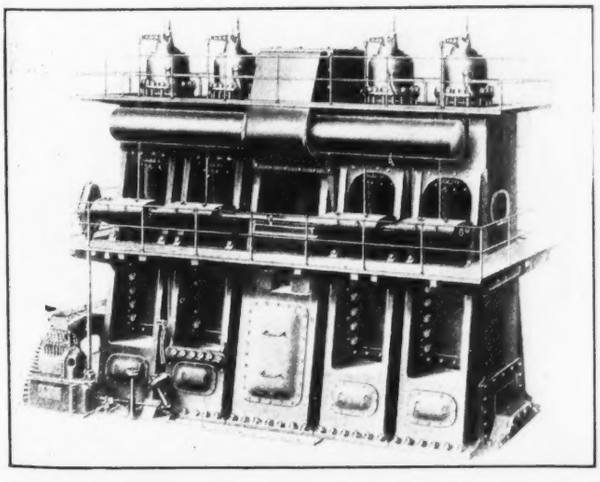
Once this fundamental idea of the engine is grasped, the design is seen to be quite simple, following in all respects the best modern standards in Diesel engine practice. The plan followed for insuring the maximum strength and rigidity in the cylinder construction combined with the necessary freedom for expansion and uniformity of heat transference, and with economy in materials, is both simple and effective.

The valve gear presents no particular novelty in design. There are three fuel spray valves, one on top of the upper end of the cylinder, and two in the bottom head on opposite sides of the piston-rod, entering at an angle. One of the admirable points of the design is the ingenuity with which these two valves are worked out so as to give a uniform and symmetrical distribution of the charge around the piston rod.

The reversing mechanism, as a point of interest, is second only to the unique cylinder design. Each of the three valves has its own cam, all three geared to the same shaft. The cams are symmetrical, and all that is necessary to reverse the running direction is to shift all three cams simultaneously through 34 deg. on the shaft.

This is accomplished by a worm shaft, which in turn is actuated by an oil-operated hydraulic mechanism controlled by a four-way cock, this in turn being operated by a single lever on the manoeuvring platform.

The engine is started and stopped by a single lever, which as it is moved forward successively opens the air starting valves, then the fuel supply valves, simultaneously closing the air starting valves; the lever being then capable of setting, by a ratchet and pawl, at any desired fuel supply. To stop, all that is necessary is to throw



Newly designed two-cycle double-acting Diesel engine. This four-cylinder unit is ready for installation

this lever back to the stop position.

The starting and stopping lever and the reversing lever, though independent of each other in all other respects, are interlocked so that the engine must be brought to a full stop before reversing. Manoeuvring control is, therefore, practically as simple and effective as that of a reciprocating steam engine, and much more prompt and efficient than that of a steam turbine.

Every effort has been made, in all the auxiliary mechanism as well as in the engine proper, to secure the utmost possible simplicity both in design and operation, that can be combined with the highest efficiency and reliability. Scavenging, cooling and lubrication, for example, are all believed to represent a new level of thoroughness and efficiency in Diesel engine practice, and this is typical of the engine as a whole.

Another Diesel Shovel and Dragline Excavator

A further addition to its line of Diesel shovels and dragline excavators has recently been announced by the Bucyrus Company. This machine, which is the largest of its three small revolving machines, is known as the 50-B. In dipper capacities and working ranges it is similar to the 50-B steam shovel and dragline. As a shovel it carries a 1¾-yd. dipper, and may be had with standard high-lift or extra high-lift booms, thus adapting it to a very broad range of digging conditions. As a dragline it may be had with a variety of boom and bucket combinations, ranging from a 45-ft. boom with a 1½-yd. bucket to a 60-ft. boom with a ¾-yd. bucket. As is the case with the steam machine, it may also be had with crane or clamshell bucket equipment.

The company is the only manufacturer who has equipped its machines with a straight Diesel engine. The outstanding feature of the Diesel engine is that it not only burns a low-grade fuel oil that can be purchased at from one-sixth to one-eighth the cost of gasoline but that the fuel consumption has been found to be but a fraction of that of the gasoline machine.

Mine Motors Dried Out After Five Days Under Water

After being completely under water for a period of five days, five 1,000-hp. pump motors in the mine of the Glen Alden Coal Co. in the Lackawanna Valley were successfully dried out and again placed in service.

The flood from the Lackawanna River entered one of the collieries at the rate of 700,000 gal. per minute. The Hampton Water Shaft Pumping Station served this draining area with five centrifugal pumps driven by five 1,000-hp., 2,200-volt, 3-phase, 60-cycle, 870-r.p.m. induction motors, four of which were Westinghouse motors.

In spite of the large capacity of the pumps, at the end of six hours the pumps and motors were completely submerged, and the water finally rose about 25 ft. over the tops of the motors.

It was five days before one of the pumps could be reached, and the pump and motor were found half buried in mud and silt, several hundred tons of which had to be removed before the pump could be placed in operation. One by one the motors were disengaged from the pumps and taken outside, with the exception of the motor on the pump farthest in the mine working.

These motors were disassembled, cleaned off with a fire hose, and dried in a temporary wooden inclosure built around them. This building was open at the bottom and ventilated at the top, and a temperature of 90 deg. Centigrade was maintained by circulating steam through coils of piping. This arrangement required little attention and gave a constant temperature.

The motors were dried for a period ranging from seven to eleven days until meter readings showed a constant value for a period of twenty-four hours or longer. After being thoroughly cleaned out, painted, and the swollen slot wedges trimmed, the armature windings were put back and the motors placed in operation again. They have been in service since this time and have given no trouble.

One motor which was left inside the mine was covered with a wooden house and dried by Westinghouse space heaters. Small fans gave the necessary ventilation. This job required closer attention and took longer to dry than in the case of the other motors.

The starting panels, oil switches, and all other apparatus were put in service after being cleaned and dried by blow torches and space heaters. The only failure of the entire outfit was a short piece of cable stretching from busbar to the oil switch.

A New Motor Starter

A new automatic starting compensator, CR-7051-J1, for squirrel-cage induction motors, has been developed in order to make possible the remote control of constant speed two- or three-phase squirrel-cage motors up to 600 volts for driving line shafting, pumps, compressors, blowers, conveyors and similar machinery. With it such equipment may be started or stopped from a distance by means of one or more small hand-operated push-buttons or snap-switches located within convenient reach of the operator or automatically operated by pressure governor, float switch, or thermostat.

The General Electric Co., which will manufacture this compensator, has incorporated various new and important features. Definite and adjustable time acceleration is obtained by means of a new induction-type relay. Positive overload protection of the complete equipment is obtained by a double-pole, inverse-time, temperature-overload relay. The starting and running magnetic contactors are mounted back-to-back in a sheet-steel inclosing case providing easy access to all parts. Several taps on the auto-transformer provide for adjusting the low voltage, for starting to suit the requirements of different installations.

All parts are protected by the steel inclosing case, and a conduit box at the back has several knock-outs and furnishes entrance for all power and control wires to the motor starter.

Trade Catalogs

Shovels. Bulletin 247 of the Osgood Company, Marion, Ohio, which has just been issued, is intended to serve the dual purpose of describing the Osgood continuous treads for railroad type shovels and of giving a brief history of the development of the standard railroad shovel. It contains eight pages and will be sent free on request.

Road Machinery. The Austin Manufacturing Co., 400 North Michigan Ave., Chicago, Ill., has issued a catalog covering its new "Leaning Wheel" grader and a circular on its new power grader. Both of these machines have just been introduced.

Line Material. Recent developments in design and construction of line material for mines are described in a new booklet (Folder 4620) being distributed by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. One of these developments is the new ball-and-socket mine clamp, which is described and illustrated in this booklet. The advantages of this clamp over the cumbersome clamps now being used are clearly explained. Other improvements in mine suspension double-gap section insulators, splicers, trolley frogs and feed wire insulators are described.

Condensers. The Westinghouse Electric & Manufacturing Co. has issued an attractive 44-page booklet, Circular No. 1662, on steam condensers of the surface, low-level jet, and barometric types, as well as auxiliary equipment, including air removal apparatus, pump drives, motors, and control equipment. The apparatus described is well illustrated with photographic cuts and performance charts, and makes a valuable reference book.

Compressors. Bulletin No. 1540 has been issued by Allis-Chalmers Manufacturing Co., Milwaukee, Wis., in which are covered compressors and blowing engines. These, it is stated, may be had complete with Corliss steam engine, gas engine or synchronous electric motor drive.

Hammer Drills. The Denver Rock Drill Manufacturing Co., Denver, Colo., has issued a new bulletin describing its newest independent rotation sinker —the Model 37 Turbo Waughammer. This model is intended for all classes of work where hand hammer drills are used.

Gyratory Crusher. Allis-Chalmers Manufacturing Co., of Milwaukee, Wis., has issued a bulletin (No. 1461) describing the Superior McCulley fine reduction gyratory crusher. This crusher comes in two sizes, 6 in. and 10 in. The 6-in. crusher has a capacity of 24 short tons per hour ¾ in. discharge, ranging to 48 tons for 1½ in. discharge. The capacity of the 10-in. crusher ranges from 80 short tons per hour 1½ in. discharge to 135 tons for 2½ in. discharge.

Gears. Catalog No. 29 of the W. A. Jones Foundry & Machine Co., Chicago, Ill., is entitled "Jones Gears." It covers every kind of gear, from those of giant size to pinions, and made from cast iron, cast steel, forgings, rawhide, bakelite, and with teeth cut or molded-spur, bevel, worm.

The Market Report

Daily Prices of Metals

Sept.	Copper, N. Y. net refinery	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
4	13.25 @13.375	51.75	52.25	8.00	8.00	6.25
5	13.125@13.25	51.625	52.125	8.00	7.95	6.20@6.25
6	13.125@13.25	51.50	52.00	8.00	7.90	6.20
8	13.00 @13.125	50.50	51.00	8.00	7.90	6.15@6.175
9	13.00	50.50	51.00	8.00	7.85	6.15@6.175
10	13.00 @13.125	50.50	51.00	8.00	7.85	6.175
Av.	13.135	51.063	51.563	8.00	7.908	6.196

*These prices correspond to the following quotations for copper delivered: Sept. 4, 13.50c.@13.625c.; 5th, 13.375c.@13.50c.; 6th, 13.375c.@13.50c.; 8th, 13.25c.@13.375c.; 9th, 13.25c.; 10th, 13.25c.@13.375c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
4	63½	64½	68¼	256	256¾	33⅛	32⅛	33	32¾
5	63½	64½	68	257¾	258½	33⅛	32⅛	33	32¾
8	63⅛	64⅛	67¾	253½	254⅛	33¼	32¼	33⅛	32¾
9	63⅛	64⅛	67¾	252½	253½	33⅛	32¼	33	32¾
10	63	64	67½	252¼	253⅝	33⅛	32¼	33	32¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Sept.	Sterling Exchange "Checks"	Silver		Gold London	Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
4	4.45¾	68½	34⅜	92s 05d	8	4.43	68⅞	34¾	93s ..
5	4.45⅝	68⅝	34 7/16	92s 09d	9	4.43¼	69	35	93s05d
6	4.43⅛	68⅞	34 13/16	... ...	10	4.44¾	69¼	35	93s ..

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Metal Markets Quiet; Slight Declines in Evidence

New York, Sept. 10, 1924—Business in the non-ferrous metals has been light. Domestic consumers have been only moderately interested in lead, while the manufacturers of copper and zinc products have had to be tempted by price reductions before purchasing their raw material. A better sentiment is noticeable in the market today, and has been reflected in a stiffening of the copper and zinc prices, but the sales made are still small in volume.

Copper Market Easier

The tonnage of copper sold during the week has been considerably below normal. The largest factors in the market have made relatively small sales, the bulk of the business going to their smaller-sized competitors. Last Thursday 13⅝c. per lb. delivered was secured for the metal, the market sagging almost daily until yesterday, when a fair sized quantity brought 13¼c. to domestic consumers. The demand from foreign sources has also declined and has been reflected in the price at London. English dealers seem to have taken most of the business available abroad. The unreceptive condition of the market last Friday and Saturday in New York is illustrated by the efforts of one producer who unsuccessfully tried to sell lots of several hundred tons at 13¼c. delivered. Today some producers are asking 13⅜c., but the market remains quiet. Consumers seem to be interested mainly in September and October delivery. Very little forward business was done during the week.

New York Lead Firm; St. Louis Market Declines

The official contract price of the American Smelting & Refining Co. continues at 8c. per lb., New York.

The New York lead market has remained at 8c. per lb. throughout the week, with sales made freely at that level. Premiums for prompt shipment are no longer obtainable, and although the supply of September lead generally in the hands of producers is relatively small, the demand for prompt shipment has decreased for the time being. At present lead prices, however, producers have not much inducement for accumulating a stock. In St. Louis the price of lead has become softer, and it looks as if the normal differential between the New York and St. Louis markets—equal to the freight rate between these points—may again be expressed in the quotations. Owing to the world shortage of lead and to other factors, the true relation of these markets has seldom been established in the last two years. The first cut in the St. Louis market carried the price down to 7.95c.; from there it dropped to 7.90c. and then down to 7.85c., at which price it can be readily obtained today. Some corroding metal was sold in Chicago for 8.05c. per lb. last week. Inquiry continues to be fair in both New York and St. Louis, but actual business negotiated has been lighter than usual.

Conditions in the three most important lead-consuming channels are bright. Storage-battery manufacturers expect a much improved market for their product in the fall, after having a poor second quarter. Cable and electrical manufacturers are using more lead than anticipated, while paint dealers are believed to be low in their supply of pigments. A feature of the market during the week has been the sale of large amounts of bonded lead to foreign purchasers, indicating a continuation of the good demand abroad. It is noteworthy that the London market is holding firm, despite the easier position here.

Correction

London three month lead quotations were incorrectly stated in the Sept. 6 issue. The correct figures follow: Aug. 28, 32¼; 29th, 32¼; Sept. 1, 32¼; 2d, 32⅜; 3d, 32⅜.

Price of Zinc Drops and Recovers

Sales of zinc were heavy by one important producer, but light by others. Large amounts of both Prime Western and Brass Special were sold. For the Prime Western grade prices ranged from 6.25c. down to 6.15c. St. Louis;

Brass Special commands a premium of 2½ points. There was quite a bit of scrambling among producers for the business of consumers, with the sale generally made by the most aggressive producer. The market is stronger today, with 6.175c. asked and received. In fact, one producer is asking 6.20c. Most of the zinc sold was for September shipment, with here and there an order for October and November delivery. Forward metal is at a discount under spot. High-grade zinc continues to be sold for 8@8¼c. delivered.

Tin Market Declines

The absence of any but a passing interest in the tin market by consumers has caused prices to drop. Dealers, however, remain important speculative factors. Straits tin declined as low as 51c. during the week.

Arrivals of tin through Sept. 8 were 1,405 long tons.

Silver Up to 69¼c.

A new high price of 69¼c. in the New York market was established on Sept. 10. Buying for account of the Continent, India, and China caused the improvement. The reappearance of China in the market is a most encouraging feature.

Mexican Dollars—Sept. 4, 52⅜c.; 5th, 52⅜c.; 6th, 53; 8th, 53; 9th, 53¼c. 10th, 53¼c.

Foreign Exchanges Strong

The foreign exchange market, after the recent setback, has reacted to a higher level. On Tuesday, Sept. 9, francs were 5.28c., lire, 4.365c. and Canadian funds in New York 3/32 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese brands, 10¾@11c.
W. C. C. brand, 13c.
Cookson's "C" grade, 13@13¼c.
Chinese needle, lump, nominal, 8½@9c.
White oxide, Chinese, 99 per cent Sb_2O_3, 11½@13c.

Bismuth—$1.85@$1.90 per lb. London, 7s. 6d.

Cadmium—60c. per lb. London, 2s. 6d.

Cobalt—$2.50@$3 per lb. for spot.

Iridium—$260@$270 per oz.
Iridium alloyed with platinum, $280 @$286.

Nickel—27½@28½c. per lb. for 99 per cent virgin metal. London, £135 long ton.

Osmiridium—Crude, $58.50 per oz.

Osmium—$95@$104 per oz.

Palladium—$78@$83 per oz. Crude, $60 per oz.

Platinum:
Refined, $120 per oz.
Crude, $112@$114.

Quicksilver—$73 per 75-lb. flask. San Francisco wires $71.65; London, £13¾.

Rhodium —$85@$90 per oz.

Ruthenium—$40@$45 per oz.

The prices of Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Radium, Selenium, Tellurium, Thallium, Tungsten and Zirconium are unchanged from the prices given in the Sept. 6 issue.

Metallic Ores

Chrome — $19@$24, depending upon grade and source. Nominal.

Manganese—42@46c. per long ton unit, seaport, c.i.f. Nominal.

Molybdenum—70c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $8.50@$8.75.
High-grade scheelite, $9.
Ordinary grades, $8.25@$8.50. Nominal.

Iron Ore, Magnetite, Tantalum, and **Vanadium** are unchanged from Sept. 6 quotations.

Zinc and Lead Ore Market Unchanged

Joplin, Mo., Sept. 6, 1924

Zinc Blende

	Per Ton
High	$45.15
Premium, basis 60 per cent Zn.	$43@$44.00
Prime Western, 60 per cent Zn.	$43@$43.50
Fines and slimes	$42@$40.00
Average settling price, all	$42.66

Lead Ores

High	$110.75
Basis 80 per cent lead	$110.00
Average settling price, all	$100.53

Shipments for the week: Blende, 14,213; lead, 1,658 tons. Value, all ores the week, $783,100.

Buying was notably light, totaling only 10,920 tons, against a production of 14,500 tons, and a shipment of 14,213 tons of zinc. Lead shipments show a falling off. Though offerings on zinc were lowered in a number of instances, and buying was light, there is no report of the general selling price being changed.

Platteville, Wis., Sept. 6, 1924

Zinc

	Per Ton
Blende, basis 60 per cent zinc	$46.00

Lead

Lead, basis 80 per cent lead	$110.00

Shipments for the week: Blende, 701 tons; lead, none. Shipments for the year: Blende, 21,141; lead 720 tons. Shipments for the week to separating plants, 1,258 tons blende.

Non-Metallic Minerals

Asbestos:
Crude No. 1—$300@$325.
Crude No. 2—$150@$200.
Spinning fibers—$90@$125.
Magnesia and compressed sheet fibers —$50@$90.
Shingle stock—$45@$55.
Paper stock —$25@$40.
Cement stock—$15@$25.
Floats—$6@$12.
All per short ton, f.o.b. mines, Quebec, tax and bags included.

No. 1 Rhodesian crude, $280; No. 2, $175 per short ton, c.i.f. New York.

Amblygonite, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli and **Zircon** are unchanged from Sept. 6 prices.

Mineral Products

Arsenious Oxide (white arsenic)—7½c. per lb. Market quiet.

Copper Sulphate—4.75c. per lb. for domestic in carload lots.

Potassium Sulphate, Sodium Sulphate, Sodium Nitrate and **Zinc Oxide** are unchanged from Sept. 6 prices.

Ferro-Alloys

Ferromanganese — $92.50@$95 per gross ton.

Ferrotungsten — Domestic, 88@90c. per lb. contained tungsten.

Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferro-uranium and Ferrovanadium are unchanged from the prices given in the Sept. 6 issue.

Metal Products

Copper Sheets, Lead Sheets, Nickel Silver, Yellow Metal and **Zinc Sheets** are unchanged from Sept. 6 prices.

Refractories

Chrome Brick—$45@$47 per net ton, f.o.b. Chester, Pa.

Firebrick — First quality, $40@$43 per M, Central Pa. works, Southern Ohio and Kentucky; second quality, $33@$37.

Magnesite Brick—$65@$68 per net ton, Chester, Pa.

Silica Brick—$35@$38 per M., Pa.; $48@$50, Birmingham.

Bauxite Brick, Magnesite Cement, and **Zirkite** are unchanged from Sept. 6 prices.

Iron Trade Shows Slight Gain

Pittsburgh, Sept. 9, 1924

General line buying of steel products, by jobbers and ordinary manufacturing consumers, continues to show a slight increasing tendency. The buying is widespread. Agricultural sections are not doing better than other sections to any really noticeable extent.

Steel mill operations have now mounted to an average of fully 55 per cent, against not over 40 per cent at the low point two months ago and an average of about 66 per cent since the armistice.

No quotable change in market price of any important steel mill product is to be recorded in the last week, and there has been little change for several weeks. Declines that have occurred this year have been in proportion to the aggressiveness of the competition in the various lines.

Pig Iron—Sales not heavy, but ample to substantiate recent quotations of $20 for bessemer, $19 for basic, and $20 for foundry, f.o.b. Valley furnaces, and the next change seems likely to be upward.

Connellsville Coke—Additional fourth-quarter furnace coke business has been done at $3.25, or 25c. over third quarter. Spot furnace coke is a shade easier again, at $3@$3.10, with foundry unchanged at $4@$4.50.

German Metal Conditions After the London Conference

By Dr. James Rubinfeld, Berlin

IT IS A LONG WAY to improvement in the metal market in this impoverished country even after the termination of the London conference, which gives some positive benefits to Germany with regard to loans and rawstuff credits. The vacuum in the engineering, cable and building trades in adequate metal supply remains. A normal state of employment may bring about a rush of buying orders for metals of every kind, but thus far the movement of shutting down plants and mills for lack of working capital and money for meeting maturing debts continues. Copper consumption is only at the rate of about 6,000 metric tons a month, compared with nearly 7,500 tons, the average for 1923. It must be emphasized that the transit figures of copper to Czechoslovakia and the Balkan countries are improperly included with copper consumed by Germany alone, and that the 6,000 tons mentioned would be reduced were it not for the increased tacit long credits granted recently by British and American firms to German customers or the direct interest taken by foreigners in the business of important consumers, as is, openly, the case with regard to the important Metallgesellschaft of Frankfort-on-Main, which succeeded in emerging from the paper mark swamp with foreign help.

Secondary Supplies Low

Another reason for importing more raw copper in every shape is the growing lack of old metal, especially copper and brass (or lead), as well as bronze. It is, for the time being, a paying proposition for the efficient German smelters to smelt and refine old and mixed material as a consequence of cheaper fuel supplies and lower working costs. As a matter of fact, the copper and brass rolling mills are only moderately booked with orders, and German cathodes are, therefore, on offer, whereas cable and storage-battery makers cannot complain of wholesale absence of orders, but are well employed. The latter fact also accounts for some imports of electro copper into Hamburg and Rotterdam.

Copper circles here maintain that there can be no genuine improvement in the world copper market as an entirety so long as the producers are not disposed to help the old established firms (not the new jobbers and traders) by granting them long term credits on friendly terms. The same may be said for the nickel market, the sick conditions of which will alter the moment when European consumers can find the wherewithal to pay for the cheap commodity, for since the Rhur struggle it is the big tool steel makers of Germany who are devoid of funds. Recently the very big steel concern of Becker, at Willich, declared its insolvency.

With regard to nickel plate, different conditions prevail, and manufacturers are not able to stand the competition of foreign makers in the world markets. But there cannot be any serious doubt that with the restoration of normalcy copper and nickel will find again a wide outlet in Germany, for the cable and wire manufacturers will continue to be large consumers and the manufacturers of German-silver ware will once more outstrip those of aluminum kitchen utensils which are taken here as some kind of makeshift.

State Assistance

The Mansfield Copper Co., which was about to close down owing to the slump of copper, has received state assistance to carry on with the hope that good times may recur for this metal later. The Otavi Mines & Railway Co., of South Africa, which may be regarded as a German-owned concern, has recently increased its plant investments and extraction machines, and it is expected that its outturn of copper-lead-silver ores will rise to 180,000 tons in the current year.

The zinc situation is far from satisfactory, since the Kattowitz Zinc Syndicate had begun some months ago to export the metal to Great Britain, where the Recovery Act toll of 26 per cent of invoice values has once again cut through this hopeful business. The building activities here are nearly nil, and there is sharp competition in the galvanized sheets markets from Belgian parts in western Germany, where sheet prices are heavily undercut, with the result that German rollers are compelled to return to sliding scales for western and southern German parts. The five zinc-rolling mills of Polish Upper Silesia, which are provided with twenty-eight ovens, are now making sheets only at the rate of around 2,200 tons a month, and the by-production of around 2,000 tons of cadmium, is, for the time being, negligible, owing to the slump in the dyes trades of this country. The export figure of 500 tons of zinc dust has been much reduced, while the dumps of the Silesian mines contain probably 50,000 to 80,000 tons of galena and blende which await being worked up, whereas in normal times Upper Silesia consumes 45,000 tons of galena and 220,000 of roasted blende. Plans are under consideration to establish independent smelters in German (western) Upper Silesia in the coming years, with the view to providing for the needs of Germany when the German-Polish agreements have elapsed.

Lead Still Scarce

The scarcity of lead continues here as abroad, the more so as cable and battery makers are busy. Even German secondary lead, the so-called Berliner Blei, is often dearer than virgin foreign lead when needed promptly. The output of virgin lead in Eastern Upper Silesia amounts now to approximately 1,250 tons a month, and remaining Germany accounts for another 2,000 or thereabouts (included certain brands of secondary metal). But requirements are probably 50 per cent more, and are bound to increase further by leaps and bounds when the building activity starts again.

Tin plate is often imported from England rather than manufactured here, because most of the German tin plate mills are situated in the dislocated Ruhr district, where working costs are still high.

Those interested in aluminum here are turning their eyes upon the approaching opening-up of the Inn-Werk of Bavaria, which will put this very young industry upon a cheap water-power basis instead of brown-coal power as hitherto. The Rhineland work of Grevenbroich, the so-called Erftwerk, is now in full swing again, so that the needs for aluminum may be fully covered. The entire European aluminum production—that is to say, the British Aluminum Co. included—is now controlled with regard to price agreements. Recently the Swiss members suggested an all-round price increase up to 3.20 Swiss francs a kilo, but the German industry opposed vigorously to this intention, so it was not further entertained, although it was pointed out by the movers that the Aluminum Company of America follows a monopolistic price policy, which, by the help of a high tariff barrier, brings the American price above the European one.

American Silver Purchases

The Reichsbank purchases of silver with the American silver producers continue to arouse much interested talk here, and people wonder whether the Central Issuing Bank will once more succeed in catching the silver speculators napping, when it proceeds to add another lot of silver to its coinage reserves. On the other hand, a set of economists sustain the opinion that Germany cannot afford to buy silver so long as the present aluminum-bronze coins find, as they really do, the favor of the public, which, by the way, is content to handle hard money of whatever metal. The silver coins of Germany which are now in circulation are of such a poor silver content as to justify in some degree the remark that they are even of a poorer quality than the English coins.

Transvaal Gold Production

Transvaal gold production for the years 1920 to 1924 inclusive, excepting the final months of the last-named year, follow. Production for July of 1924 was the highest for years.

	1920 Fine Oz.	1921 Fine Oz.	1922 Fine Oz.	1923 Fine Oz.	1924 Fine Oz.
January	670,503	651,593		764,469	796,768
February	625,330	558,137	639,728	704,970	760,617
March	707,036	671,123		761,586	795,671
April	686,979	681,382	511,338	743,651	768,923
May	699,041	687,776	629,786	786,564	809,003
June	715,957	678,490	675,697	755,309	773,053
Total (six months)	4,104,846	3,928,501	2,456,549	4,516,549	4,704,035
July	736,099	689,555	730,635	754,306	829,437
August	702,083	711,526	752,490	769,371	.....
September	682,173	691,026	747,089	739,504	.....
October	662,472	707,825	778,159	793,842	.....
November	633,737	704,236	764,476	780,639	.....
December	632,215	681,847	790,712	778,849	.....
Total (12 months)	8,153,625	8,114,516	7,020,110	9,133,060	.....

Company Reports

St. Joseph Lead Company and Subsidiary Companies

A statement of the net income of the St. Joseph Lead Company and subsidiary companies for the six months ended June 30, 1924, follows:

Net income	$5,759,197.13	
Less provision for depreciation	348,294.78	
Balance		$5,410,902.35
Fixed charges		156,216.49
Balance		$5,254,685.86
Provision for depletion		1,151,627.98
Surplus for the period after deducting depletion		$4,103,057.88

Note—No provision has been made for federal income taxes for the six months ended June 30, 1924.

McIntyre Porcupine Mines, Ltd.

Gold, Silver; Ontario

McIntyre Porcupine shows a net profit before depreciation for the year ended June 3, 1924, of $1,400,468.95. Dividends totaling $559,639.15 were paid during the year and production amounted to 157,702 oz. of gold and 27,550 oz. of silver, valued at $3,291,178.22. Balance sheet and income account follows:

Assets

Current assets		
Cash in banks and on hand	$514,757.20	
Bullion in transit	264,261.90	
Bullion and precipitates on hand	16,000.00	
Dominion of Canada bonds, at par value	1,000,000.00	
Accounts and interest receivable	49,457.58	
Supplies on hand at cost	167,804.77	
		$2,012,281.45
Investments		1,326,077.21
Fixed assets		5,705,300.01
Deferred charges		
Operating and administrative prepayments		4,408.74
		$9,048,067.41

Liabilities

Current liabilities		$189,235.87
Reserves		
General reserve	$148,987.03	
Reserve for depreciation, plant and equip.	1,582,355.60	
		1,731,342.63
Capital stock, authorized 800,000 shares at $5 par	4,000,000.00	
Capital stock, issued, 798,000 shares at $5 par		3,990,000.00
Surplus		3,137,488.91
		$9,048,067.41

Continuous operations upon an enlarged scale have been carried on throughout the year, made possible for the first time in several years by an adequate supply of hydro-electric energy, and with the largely increased power facilities now available to the Porcupine district, it is very improbable that any future handicap in this respect can recur.

The results obtained from development work during the last year, especially on the lower levels, have been quite satisfactory, and warrant preparation for future operations on a scale which cannot be put in effect economically through the present openings. The No. 5 and main shafts, originally planned in connection with preliminary development work, have now attained a depth of 2,500 ft. and have practically reached the limit of their capacity. The general trend of the orebodies is toward the east, and consequently, at a point approximately 2,500 ft. east of the main shaft, it has been decided to immediately start sinking a central shaft, having an objective of 4,000 ft. in depth and of sufficient size to provide the necessary facilities for economical mining.

The company has during the period under review acquired further substantial interests in adjoining properties and now owns a 75 per cent interest in the Platt Veteran property, comprising 160 acres on the southeast, and approximately 98 per cent of the Plenaurum, comprising 120 acres on the northeast. As a matter of policy it may be said that the management is active in the enlargement and development of operations and the exploration and acquisition of new mining properties.

Beginning with the dividend of 5 per cent payable Sept. 1, it is now the policy of the directors to pay dividends of 5 per cent quarterly hereafter, in place of the former distribution tri-yearly.

Profit-and-Loss Statement

Earnings—bullion recovery		$3,291,178.22
Operating costs		
Mining and development	$1,139,819.20	
Crushing and conveying	67,743.79	
Milling	354,851.73	
Miscellaneous costs	53,038.36	
	$1,615,453.08	
Administrative and general expense	172,878.91	
Total operating costs before taxes and depreciation		1,788,331.99
Operating profit before taxes and depreciation		$1,502,846.23
Non-operating revenues		
Interest, exchange and discounts earned	$69,815.27	
Miscellaneous earnings	7,721.83	77,537.10
		$1,580,383.33
Municipal, Provincial and Dominion taxes for current year		91,914.38
Net profit—before depreciation—transferred to surplus		$1,488,468.95

Surplus Account

Surplus at July 1st, 1923		$1,795,614.99
Add:		
Premium on sale of 60,000 shares of capital stock	$611,272.10	
Reinstatement of cost of Plenaurum shares and notes, previously charged to surplus account	195,239.14	
Net profit, current year	1,488,468.95	
		2,294,980.19
		$4,090,595.18
Deduct three dividends totaling	559,639.15	
Sundry adjustments	937.39	
Development undistributed—written off	96,901.23	
Provision for depreciation, buildings and equipment, for current year	295,628.50	
		953,106.27
Surplus, June 30, 1924		$3,137,488.91

Hecla Mining Co.

Lead; Burke, Idaho

A statement of the Hecla Mining Co.'s operations for the second quarter of 1924, is as follows:

Gross income		$677,605.30
Operating expenses	$326,066.91	
Taxes accrued	32,000.00	
Depreciation (estimated)	30,000.00	388,066.91
Net profit		$289,538.39
Tons mined		62,411
Lead produced, lb.		10,358,335
Average lead price, per lb.		7.13
Silver produced, oz.		278,975
Average silver price		$0.67

Iron Cap Copper Co.

Copper; Arizona

During the second quarter of 1924 the production of Iron Cap Copper Co. was 1,332,569 lb. of copper, 15,935 oz. of silver, and 79 oz. of gold.

Income for the quarter	$130,706.99
Expense for the quarter	144,316.50
Loss	$13,609.51

Freight Rates on Metals, Ores, and Concentrates

Carload Lots

Copper Bullion and Refined Copper

From	To	Rate per Ton of 2,000 Lb. All Rail	Via Gulf
El Paso, Tex.	Baltimore, Md.	$11.40	$10.00
Garfield, Utah	Perth Amboy	12.50	.....
Garfield, Utah	San Francisco	5.85	.....
Hayden, Ariz.	Perth Amboy	14.50	12.50
Miami, Ariz.	Perth Amboy	14.50	12.50
Anaconda, Mont.	Perth Amboy	12.50	.....
Butte, Mont.	Perth Amboy	12.50	.....
Humboldt, Ariz.	Chrome, N. J.	14.50	12.50
Douglas, Ariz.	Perth Amboy	14.50	12.50
Globe, Ariz.	Perth Amboy	14.50	12.50
Clifton, Ariz.	Perth Amboy	14.50	12.50
Clarkdale, Ariz.	Chrome, N. J.	14.50	12.50
Copperhill, Tenn.	Laurel Hill, N. Y.	$10.80	.....
Tooele, Utah	Chrome, N. J.	12.50	.....
McGill, Nev.	Baltimore, Md.	15.90	.....
Houghton, Mich.	New York	(a) 9.60	.....
Hancock, Mich.	New York	(a) 9.60	.....
Hubbell, Mich.	New York	(a) 9.60	.....
Dollar Bay, Mich.	New York	(a) 9.60	.....
Tacoma, Wash.	New York via Canal	Conference rate	$6.00
Anaconda, Mont.	Tacoma, Wash.	7.09	.....
Ajo, Ariz.	New York	14.50	$12.50

(a) Applies April 1 to Nov. 30.

Marine Freight Rates

New York to
- Hamburg: *$5.00 per gross ton copper and lead
- Liverpool: *5.59 per gross ton copper and lead
- Antwerp: *4.50 per gross ton copper and lead
- Havre: *4.25 per gross ton lead; *4.50 per gross ton copper

Gulf ports to
- Hamburg: *$5.00 per gross ton copper and lead
- Liverpool: *5.50 per gross ton copper and lead
- Antwerp: *4.50 per gross ton copper and lead
- Havre: *4.50 per gross ton copper

Pacific coast ports to
- Hongkong: $5.00 per short ton
- Kobe: 5.00 per short ton

Lead Bullion (Pig Lead Where Shown)

From	Rates per Ton of 2,000 Lb. To New York	To St. Louis
East St. Louis, Ill.	$7.00	.....
Pueblo, Colo.	*12.50	$9.00
Leadville, Colo.	12.50	*9.00
East Helena, Mont	12.50	9.50
El Paso, Tex.	10.00 Via Gulf	
	12.00 All Rail	7.00
Omaha, Neb.	9.60	3.65
Murray, Utah	12.50	*9.00
Midvale, Utah	12.50	*9.00
Tooele, Utah	12.50	*9.00
East Chicago, Ill.	6.40	(a) 2.00
Kellogg, Idaho	13.50	9.50
Carnegie, Pa.	3.80	(a) 5.00
Selby, Calif.	(b) 6.00	.....
Herculaneum, Mo.	(a) 8.80	(a) 1.80
Federal, Ill.	7.00	(a) 1.80
Collinsville, Ill.	7.00	(a) .75¾
Granby, Mo.	(a) 10.50	(a) 3.50
Joplin, Mo.	(a) 10.50	(a) 3.50

(a) Pig lead only.
(b) Conference rate, via canal.

Slab Zinc

From	Rates per Net Ton to E. St. Louis	New York
Donora, Pa.	(a) $4.60	$3.80
Langeloth, Pa.	(a) 4.60	3.80
Palmerton, Pa.	7.10	3.00
Hillsboro, Ill.	1.40	7.00
Danville, Ill.	2.00	6.40
La Salle, Ill.	2.00	6.70
Springfield, Ill.	3.00	7.00
Cleveland, Ohio	5.80	5.00
Moundsville, W. Va.	4.40	3.80
Van Buren, Ark.	3.80	10.80
Fort Smith, Ark.	3.80	10.80
Bartlesville, Okla.	3.50	10.50
Blackwell, Okla.	3.80	10.80
Henryetta, Okla.	3.80	10.80
Sand Springs, Okla.	3.80	10.80
Cherryvale, Kan.	3.50	10.50
Black Eagle, Mont.	9.40	12.50
Park City, Utah	9.00	12.50

(a) To St. Louis, Mo.

Zinc Ores and Concentrates

To	From	Rate per Net Ton
Bartlesville, Okla.	Altoona, Kan.	$2.10
	Pittsburg, Kan.	1.09
	Galena, Kan.	1.30
	Joplin, Mo.	1.40
	Iola, Kan.	1.09
	Baxter, Kan.	1.40
	Miami, Okla.	1.40
	Quapaw, Okla.	1.40
	Kansas City, Mo.	1.60
Sand Springs, Okla.	Miami, Okla.	2.20
	Quapaw, Okla.	2.20
	Galena, Kan.	1.50
	Joplin, Mo.	1.50
	Iola, Kan.	2.40
Dewar, Okla.	Cave Springs, Mo.	2.00
Kusa, Okla.	Cent City Spur, Mo.	2.00
Henryetta, Okla.	Chitwood, Mo.	2.00
	Galena, Kan.	1.50
	Iola, Kan.	2.40
	La Harpe, Kan.	2.40
La Harpe, Kan.	Mound City, Kan.	.50
	Oswego, Kan.	.50
	Parsons, Kan.	.50
Coffeyville, Kan.	Galena, Kan.	1.10
	Joplin, Mo.	1.22
Bartlesville, Okla. (a)	Baxter, Kan.	1.80
	Miami, Okla.	1.80
	Quapaw, Okla.	1.80

(a) Lead ore and concentrates.

Rates on Ores and Concentrates

From	To	Value of Product: $5	$10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate														
Butte, Mont.	Anaconda, Mont.	.22	.22	.22	.22	.22	.22	.22	.22	.22	.22	.22	22	.22	.22	.22
Butte, Mont.	Black Eagle, Mont. (a)	....	....	....	....	....	....	....	1.01	....	....	....	....	....	....	1.01
Great Falls, Mont.	East Helena, Mont.	....	....	1.57	....	1.76	....	1.98	....	2.43	....	....	....	....	....	2.5
Butte, Mont.	East Helena, Mont.	....	....	1.17	....	1.46	....	1.69	....	2.03	....	....	....	....	....	2.14
Paxton, Calif.	Salt Lake Smelters, Utah	....	....	....	....	....	....	....	....	6.30	7.00	7.70	....	8.35	8.60	8.85
Johannesburg, Calif.	Selby, Calif.	....	....	....	2.90	....	3.50	....	4.10	4.70	5.30	5.90	....	6.50	6.80	7.10
Johannesburg, Calif.	Humboldt, Ariz.	....	....	....	3.40	....	4.10	....	4.80	5.50	6.20	6.90	....	7.60	8.00	8.30
Pioche, Nev.	Humboldt, Ariz.	....	4.50(c)	7.74	....	8.55	....	9.36	....	9.99	....	....	11.25	....	....	12.42
Creede, Colo.	Durango, Colo.	....	....	3.25	3.50	3.75	4.00	....	4.25	4.75	5.25	5.75	6.05	....	....	7.10
Ouray, Colo.	Durango, Colo.	....	....	4.30	4.80	....	5.05	....	....	5.90	....	6.30	....	....	....	7.70
Kokomo, Colo.	Durango, Colo.	....	6.00	....	....	6.50	7.20	....	....	....	....	....	....	....	....	....
Telluride, Colo.	Durango, Colo.	....	....	....	....	....	4.30	....	5.00	5.50	6.00	6.30	....	6.60	7.10	7.70
Silverton, Colo.	Durango, Colo.	....	....	1.40	1.40	....	....	2.20	....	....	2.30	2.55	....	2.80	....	2.80
Tyrone, N. M.	Douglas, Ariz.	....	....	1.60	1 90	....	2.20	....	2.50	2 80	....	....	3 10	....	....	3.40
Tyrone, N. M.	El Paso, Tex.	....	....	1.60	1 90	....	2.20	....	2.50	2 80	....	..	3.10	....	....	3.40
Lordsburg, N. M.	Douglas, Ariz.	....	1.00	1.30	1.60	....	1.90	....	2.20	2 50	....	....	2.80	....	....	3.40
Lordsburg, N. M.	El Paso, Tex.	....	1.00	1.30	1.60	....	1.90	....	2.20	2.50	....	....	2.80	....	....	3.40
Tombstone, Ariz.	Douglas, Ariz.	....	....	.60	....	.90	....	....	....	1.30	....	....	1.60	....	....	1.90
Tombstone, Ariz.	El Paso, Tex.	....	....	1.90	....	2.50	....	....	....	3.80	....	....	4.40	....	....	4.40
Silver City, N. M.	Douglas, Ariz.	....	....	2.48	....	3.15	....	....	....	3.83	....	....	....	....	....	5.29
Ray Junction, Ariz.	Hayden, Ariz.	....	.10	....	.40	....	.50	....	.80	.90	....	....	1.00	....	....	1.10
Sandon, B. C. / Alamo Concentrator, B. C.	Tadanac, B. C.	1.50	1.60	1.70	1.90	2.00	2.50	....	2.60	2 90	3.40	3.50	....	3.70	3.80	3.90
Rossland, B. C.	Tadanac, B. C.	.90	.90	1.00	1.00	1.10	1.50	....	1.60	1.60	1.60	1.70	....	1.70	1.70	1.70
Rossland, B. C.	Tadanac, B. C. (d)	.30	.30	.30	.30	.50	.70	....	.80	.80	....	....	....	....	....	....
Republic, Wash.	Tadanac, B. C.	....	2.02	2.50	2.66	2.86	3.84	....	3.84	3.84	4.69	4.89	....	5.19	5.39	5.59

(a) Minimum tonnage of 200 tons per day. (b) In open cars, minimum 80,000 lb. (c) Siliceous ore tailing.
(d) Applicable on ore, only when shipped in trainload lots of not less than 10 cars and exclusive of switching charges at Rossland.

From	To	Value of Ores and Concentrates: $10	$15	$20	$25	$30	$35	$40	$50	$60	$70	$75	$80	$90	$100
		Rate													
Burke, Idaho (a)	Bradley, Idaho	....	....	....	....	....	....	....	....	.68	....	.....	....	....	1.02
Burke and Wallace, Idaho (d)	East Helena, Mont.	....	....	....	....	3.00	....	3.25	3.50	3.75	4.00	.....	4.25	4.50	4.75
Sagel, Idaho	East Helena, Mont.	....	....	....	3.38	....	3.83	....	4.16	....	....	.....	....	.....	4.84
Arizona Tunnel, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	....	.35	....	.....	....	.....	.50
Bayview, Idaho	Bradley, Idaho	....	....	....	....	....	....	....	3.75	....	....	4.37½	....	.....	5.12½
Park City, Utah	Salt Lake Smelters	1.00	1.10	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Eureka, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Tintic, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
St. Johns, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Ophir, Utah	Salt Lake Smelters	1.00	....	1.25	....	1.50	....	1.75	2.00	2.25	2.50	.....	2.75	3.00	3.25
Bingham, Utah	Garfield, Utah	....	.40	....	.75	....	....	....	.95	....	....	1.10	....	....	1.25
Cherry Creek, Nev.	Garfield, Utah (c)	....	....	4.60	....	5.10	....	5.60	6.10	6.60	7.10	.....	7.60	8.10	8.60
Cherry Creek, Nev.	Garfield, Utah (b)	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7 40	....	....
Goldfield, Nev.	Salt Lake Smelters	....	....	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Battle Mountain, Nev. (a)	Salt Lake Smelters	....	4.15	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Palisade, Nev. (a)	Salt Lake Smelters	....	2.90	3.20	....	3.80	....	4.40	5.00	5.60	6.20	.....	6.80	7.40	8.00
Mina, Nev. (a)	Salt Lake Smelters	....	....	3.60	....	4.30	....	5.00	5.70	6.40	7.10	.....	7.80	8.50	9.20
Lovelock, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Golconda, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Hazen, Nev. (a)	Salt Lake Smelters	....	....	3.20	....	3.90	....	4.60	5.30	6.00	6.70	.....	7.40	8.10	8.80
Tonopah, Nev.	Salt Lake Smelters	....	4.15	5.10	....	5.80	....	6.50	7.20	7.90	8.60	.....	9.30	10.00	10.70
Rogerson, Idaho	Salt Lake Smelters	3.00	....	3.50	....	4.00	....	4.50	5.00	5.50	6.00	.....	6.50	7.00	7.50
Georgetown, Colo.	Leadville, Colo.	....	....	3.50	....	3 75	....	4 00	5.00	5.00	5 80	.....	5.80	5.80	5.80
Shirley, Colo.	Leadville, Colo.	....	....	2.25	....	2.25	....	2.25	2.25	4.30	4.30	.....	4.30	4.30	4.30

(a) Minimum weight, marked capacity of car used, but not less than 80,000 lb. (b) Minimum weight, 80,000 lb. (c) Minimum weight, 40,000 lb.
* Indicates a change of tariff since last report.
(d) Crude ore for concentration, 30c. per ton, effective July 7.

Mining Stocks

Week Ended September 6, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	...	...	*37	...	...
Anaconda	New York	41	36⅞	37	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	1⅛	1⅛	1⅛	...	...
Ariz. Com'l	Boston	11¼	10⅝	10⅞	Jy.19, Jy.31	0.50
Calaveras	N. Y. Curb	...	...	2	...	...
Calumet & Arizona	Boston	53	51	51	Se. 5, Se. 22 Q	0.50
Cal. & Hecla (New)	Boston	17	16⅛	16½	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	4	3½	3½	...	...
Cerro de Pasco	New York	48⅛	45⅞	45⅞	Jy. 17, Au. 1	1.00
Chile Copper	New York	35⅞	32½	32⅝	Se.3, Se.29, Q	0.62½
Chino	New York	22¼	21	21	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	4	3½	3⅝	...	...
Copper Range	Boston	28	25⅛	25⅛	May, 1923	1.00
Crystal Copper	Boston Curb	*70	*64	*65	...	...
Davis-Daly	Boston	*43	*41	*43	Mar., 1920	0.25
East Butte	Boston	4⅛	4⅛	4⅛	Dec., 1919	0.50
First National	Boston Curb	...	...	*39	Feb., 1919,	0.15
Franklin	Boston	*70	*60	*60	...	...
Gadsden Copper	Boston Curb	*70	*70	*70	...	...
Granby Consol.	New York	20⅛	18⅛	18⅛	May, 1919	1.25
Greene-Cananea	New York	16⅛	16	16	Nov., 1920	0.50
Hancock	Boston	1⅛	1⅛	1⅛	...	...
Howe Sound	N. Y. Curb	2⅜	2⅛	2⅛	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	27⅛	26¼	26⅛	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	...	...	3	May, 1923	0.15
Isle Royale	Boston	17	16	16	Se. 1, Se. 15,	0.50
Jerome Verde Dev.	N. Y. Curb	1	1	1	...	...
Jib Consol	N. Y. Curb	*70	*52	*54	...	...
Kennecott	New York	49¼	46⅛	46⅛	Se.5, . Oc.1, Q	0.75
Keweenaw	Boston	...	...	*80	...	...
Lake Copper	Boston	2	2	2	...	...
Magma Copper	New York	37⅛	34⅛	34⅛	Jan., 1919	0.50
Mason Valley	N. Y. Curb	1⅞	1⅛	1⅛	...	...
Mass Consolidated	Boston	1⅛	1⅛	1⅛	Nov., 1917	1.00
Miami Copper	New York	24	22⅞	22⅝	Au 1, Au 15, Q	0.15
Mohawk	Boston	37	33	33	Se. 22, Oc. 13,	1.00
Mother Lode Con.	New York	8⅜	8	8	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	14⅞	14½	14⅛	Sept., 1920,	0.25
New Cornelia	Boston	22	21	21	Au.8, Au.25,	0.25
New Dominion	N. Y. Curb	...	...	2⅜	...	...
North Butte	Boston	4⅛	4⅛	4⅛	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	1⅛	1 1/16	1 1/16	...	...
Old Dominion	Boston	...	...	24	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†111	†107	...	Jn.21, Jy.2 Q	1.00
Quincy	Boston	...	...	22	Mar., 1920	1.00
Ray Consolidated	New York	13⅛	12⅛	12⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	*18	*18	*18	...	...
St. Mary's Min. Ld.	Boston	39	37	38	Ap.22, My.20	3.00
Seneca Copper	New York	2	1⅞	2	...	...
Shannon	Boston	*70	*55	*55	Nov., 1917	0.25
Shattuck Arizona	New York	7⅛	7⅛	7⅛	Jan., 1920	0.25
Superior & Boston	Boston	*45	*34	*34	...	...
Tenn. C. & C. cfs.	New York	8⅞	8⅛	8⅛	De.31, Ja.15, Q	0.25
United Verde Ex	N. Y. Curb	28	27⅛	28	Jy.3, Au.1	0.50
Utah Copper	New York	79⅛	77⅛	77⅛	Jn.13, Jn.30,	1.00
Utah Metal & T.	Boston	*40	*30	*35	Dec., 1917	0.30
Victoria	Boston	50	50	50	...	...
Walker Mining	N. Y. Curb	3⅛	3 1/16	3 1/16	...	...
Winona	Boston	48	48	48	...	...
NICKEL-COPPER						
Internat. Nickel	New York	18⅛	17⅛	17⅛	Jy.17, Au.1, Q	1.50
Internat. Nickel pfd.	New York	...	...	88⅛	Jy.17, Au.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4	4	4	...	...
National Lead	New York	159	147⅛	147⅛	Se.12, Se. 0, Q	2.00
National Lead pfd.	New York	117⅛	116⅛	117⅛	Au. 22, Se. 15, Q	1.75
St. Joseph Lead	New York	29⅞	28⅞	28⅞	Se. 9, Se.20	0.50
ZINC						
Am. Z. L. & S.	New York	9	8⅛	8⅛	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	31	29	29	Nov., 1920	1.50
Butte C. & Z.	New York	5⅛	5	5	Ma., 1923	0.50
Butte & Superior	New York	18⅛	16⅞	17	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4⅛	3⅞	3⅞	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	160⅛	160	160	Aug. 9, 1924	2.00
United Zinc	N. Y. Curb	...	...	*25	...	...
Yellow Pine	Los Angeles	...	...	60	June, 1924	0.04
SILVER						
Alvarado	N. Y. Curb	...	...	*90	...	...
Beaver Consol.	Toronto	*15⅛	*14⅛	*15⅛	May, 1920	0.03
Castle-Trethewey	Toronto	*73⅛	*70	*72⅛	...	...
Coniagas	Toronto	2.00	1.45	1.90	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*53⅛	*44⅛	*53	Jan., 1917	0.05
Keeley	Toronto	2.32	2.30	2.31	Sept. 15, SA	0.12
Kerr Lake	N. Y. Curb	1⅞	1⅞	1⅞	Oc. 1, Oc. 15,	0.12½
La Rose	Toronto	*9	*8	*8⅛	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.40	1.39	1.39	...	...
McKinley-Dar.-Sav.	Toronto	*15	*10	*14	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.80	2.58	2.75	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6⅛	6	6	Jn.30, Jy.21, Q	0.15
Ontario Silver	New York	6⅛	6⅛	6⅛	Jan., 1919	0.50
Temiskaming	Toronto	*18	*18	*18	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	*15	*14	*15	...	...
Alaska Juneau	New York	1⅛	1	1	...	...
Argonaut	Toronto	*37	*36	*36	...	...
Carson Hill	Boston	†1⅛	†1	...	...	...
Cresson Consol. G	N. Y. Curb	3⅛	3 11/16	3⅞	Jn.30, Jy.10, Q	0.10
Dome Mines	New York	15⅛	15	15⅛	Jn.26, Jy 21, Q	0.50
Golden Cycle	Colo. Springs	...	...	1.30	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	14.05	13.99	14.00	Au.21, Se.8, M	0.05
Homestake Mining	New York	42⅛	42	42	Se.20, Se.25, M	0.50
Kirkland Lake	Toronto	*19	*18⅛	*19	...	...
Lake Shore	Toronto	3.94	3.90	3.92	Se.1, Se.15, Q	0.05
McIntyre-Porcupine	New York	16⅛	15⅞	16⅛	Au. 1, Se. 1,	0.25
Newray	Toronto	*24	*22	*23⅛	...	...
Portland	Colo. Springs	...	...	50	Oct., 1920	0.01
Teck-Hughes	Toronto	1.30	1.28	1.28	...	...
Tom Reed	Los Angeles	20	18⅛	19⅛	Dec., '1919	0.02
Tough-Oakes	Toronto	*63	*60⅛	*62⅛	...	...
United Eastern	N. Y. Curb	...	...	*43	Jy.18, Jy.31, Q	0.05
Vipond Cons.	Toronto	1.32	1.12	1.22	...	...
Wright-Hargreaves	Toronto	3.80	3.70	3.70	Se.15, Oc. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	1⅛	1	1	...	...
Con. Cortez	N. Y. Curb	*15	*12	*15	...	...
Con. Virginia	San Francisco	6	4	5⅛	...	...
Continental Mines	N. Y. Curb	2¼	2¼	2⅜	...	...
Dolores Esperanza	N. Y. Curb	...	...	*50	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2¼	2¼	2¼	Jn.19, Jy.2	0.08
Tonopah Belmont	N. Y. Curb	*65	*65	*65	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*27	*26	*26	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	3 3/16	3	3 3/16	Se. 10, Oc. 1	0.05
Tonopah Mining	N. Y. Curb	2	2	2	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	1⅛	1⅛	1⅛	...	...
West End Consol.	N. Y. Curb	*68	*65	*68	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	6⅛	6⅛	6⅛	Se.16, Oc. 2, X	0.15
Bingham Mines	Boston	†17	†15⅛	...	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	...	...	*80	Dec., 1920	0.15
Chief Consol.	Boston Curb	...	...	2⅛	Ap 19, My.1, Q	0.10
Columbus Rexall	Salt Lake	13	12	12	Aug., 1920	0.03
Consol. M. & S.	Montreal	43⅛	43⅛	43⅛	Jn.30, Jy.15	0.75
Daly Mining	Salt Lake	...	...	2.25	July, 1920	0.10
Erupcion	Boston Curb	2⅞	2⅞	2⅞	Se. 15, Oc. 2, X	0.15
Federal M. & S.	New York	...	...	12⅜	Jan., 1909	1.50
Federal M. & S. pfd.	New York	52⅜	49⅛	49⅛	Au.25, Se.15, Q	1.75
Florence Silver	Spokane	8	8	8	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	9⅛	9	9	Sept. 15, 1924	0.25
Iron Blossom Con.	N. Y. Curb	...	...	*21	Oct., 1923	0.02
Marsh Mines	N. Y. Curb	...	...	*5	June, 1921	0.02½
Park City	Salt Lake	4.50	4.50	4.50	Jn.14, Jy.1,	0.15
Park Utah	N. Y. Curb	...	...	3⅛	Mc.15, Ap.1	0.15
Prince Consol.	Salt Lake	*7⅛	*7⅛	*7⅛	Nov., 1917	0.02
Silver King	N. Y. Curb	...	...	*50	Jn.20, Jy.1,	0.15
Silversmith	Spokane	*33	*32⅛	*32⅛	Jy.1, Jy. 10,	0.01
Tamarack-Custer	Spokane	1.30	1.25	1.30	Jn.25, Jn.30,	0.02
Tintic Standard	Salt Lake	6.30	6.20	6.30	Jy.28, '24, X	0.25
Utah-Apex	Boston	3	2⅞	2⅞	Se.5, Se.15, Q	0.25
IRON						
Bethlehem Steel	New York	46⅛	43⅛	43⅛	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	*40	*40	*40	...	...
Char. Iron pfd.	Detroit	1	1	1	...	...
Colorado Fuel & Iron	New York	38⅛	33⅛	35⅞	Au.11, Au. 25 Q	2.00
Col. Fuel & Iron pfd.	New York	108⅛	108⅛	108⅛	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	30	29	29	De.10, De.27	2.00
Inland Steel	N. Y. Curb	...	...	46	Au.15, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	...	...	2⅜	...	...
Replogle Steel	New York	12⅜	11	11	...	...
Republic I. & S.	New York	49⅜	46⅛	46⅞	May, 1921	1.50
Republic I. & S. pfd.	New York	...	...	89	Se.15, Oc.1, Q	1.75
Sloss-Sheffield S.&I.	New York	74⅛	70	70	Se.11, Se.20, Q	1.50
Sloss-Shef. S.&I.pfd.	New York	...	...	89	Se.20, Oc.1, Q	1.75
U. S. Steel	New York	110⅛	105⅞	106⅛	Se.1, Se.29 QX	1.75
U. S. Steel pfd.	New York	121⅛	121	121	Au. 5, Au. 30 Q	1.75
Virginia I. C. & C.	New York	...	...	37⅛	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	...	...	71	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	27⅜	24⅞	24⅞	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*17	*17	*17	...	...
ASBESTOS						
Asbestos Corp.	Montreal	...	...	31	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	67	66	66	Jy.1, Jy.16, Q	1.50
SULPHUR						
Freeport Texas	New York	8⅛	7⅛	7⅛	Nov., 1919,	1.00
Texas Gulf	New York	79⅛	76⅛	76⅛	Se.2, Se.15, QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛	...	...
MINING, SMELTING AND REFINING						
Amer. Metal	New York	48⅞	45	45	Au. 18, Se. 2 Q	0.75
Amer. Metal pfd.	New York	...	...	112	Au.20, Se. 2, Q	1.75
Amer. Sm. & Ref.	New York	77⅛	72⅛	72⅞	Jy.11, Au.1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	104⅛	103⅛	104⅛	Jy.11, Au. 1.	1.25
U. S. Sm. R. & M.	New York	36	31⅛	31⅛	Jan., 1921,	0.50
U.S. Sm. R.&M.pfd.	New York	45	44	45	Jy.7, Jy.15 Q	0.87½

* Cents per share † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.